Wastewater Collection System Master Plan

July 2015

in conjunction with rjngroup BURGESS & NIPLE

Walker Partners

HDR

WASTEWATER COLLECTION SYSTEM MASTER PLAN

Submitted to:

City of Waco

Engineering Administration Office
401 Franklin Avenue
Waco, Texas 76701

Submitted by:

Walker Partners

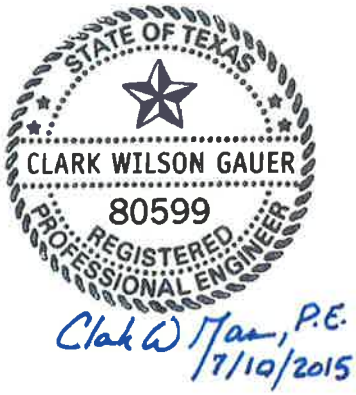
600 Austin Avenue, Suite 20
Waco, TX 76701

Contact:

Clark W. Gauer, P.E.

Project Manager
Phone: 254.714.1402

HDR, Inc.
T.B.P.E. Registration No. F-754



Walker Partners, LLC
T.B.P.E. Registration No. F-8053

July 2015

Table of Contents

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION

1.1 Purpose (Scope of Work) 1-1
1.2 Waco Metropolitan Area Regional Sewerage System (WMARSS) 1-2
1.3 Master Plan Organization 1-4
1.4 Study Area Delineation 1-5

CHAPTER 2 – HISTORICAL / INSTITUTIONAL KNOWLEDGE

2.1. Review Previous Studies, Reports and Existing Data / Information 2-1
2.1.1. Background 2-1
2.1.2. Previous Studies / Reports 2-2
2.1.3. Drawings / Maps 2-11
2.1.4. Other System Data 2-12
2.2. Description of the Existing Wastewater System 2-19
2.2.1. Major Basins 2-19
2.2.2. Collection Lines 2-23
2.2.3. Manholes 2-27
2.2.4. Lift Stations 2-28
2.2.5. Miscellaneous System Features 2-33
2.3. Identification of Problem Areas, Structurally Deficient Segments And Lift Stations 2-33
2.3.1. Background 2-33
2.3.2. Wastewater Collection System 2-33
2.3.2.1. Barron's Branch Basin 2-37
2.3.2.2. Bosque River Basin 2-38
2.3.2.3. Brazos Basin 2-39
2.3.2.4. Carver Basin 2-40
2.3.2.5. Cottonwood Basin 2-41
2.3.2.6. Flat Creek Basin 2-42
2.3.2.7. MLK Basin 2-43
2.3.2.8. Primrose 2-44
2.3.2.9. Speegleville Basin 2-45
2.3.2.10. Twin Bridges Basin 2-46
2.3.2.11. Village Lake Basin 2-47
2.4. Summary / Prioritization of City Identified Gravity Segment Deficiencies 2-48
2.5. Summary / Prioritization of City Identified Lift Stations And Force Main Deficiencies 2-53

CHAPTER 3 – SYSTEM PLANNING, POPULATION AND FLOW PROJECTIONS

3.1. Background 3-1
3.2. Land Use 3-1
3.3. Service Areas 3-2
3.3.1. Wastewater Service Envelope 3-2
3.3.2. Future Development and Maintenance Areas 3-5
3.3.3. Bull Hide Basin 3-5
3.4. Population Projections 3-6

3.4.1. Historical and Current Population 3-6
3.4.2. Projected Population 3-7
3.4.2.1. Waco MPO 3-8
3.4.2.2. Texas Water Development Board 3-8
3.4.2.3. U.S. Census Bureau 3-9
3.4.2.4. Population Distribution 3-9
3.4.2.5. Combined Scenario 3-11
3.4.3. Additional Evaluation Areas 3-16
3.4.3.1. Speegleville Basin (West US 84) 3-17
3.4.3.2. Village Lake / Carver (China Spring) 3-17
3.4.3.3. Bull Hide Basin 3-18
3.4.3.4. City of McGregor 3-18
3.4.4. Populations of Major Wastewater Basins 3-19
3.5. Wastewater Flow Projections 3-23
3.5.1. Definitions 3-23
3.5.2. Historical and Existing Wastewater Flows 3-23
3.5.3. Projected Wastewater Flows 3-26
3.5.4. City of McGregor 3-27
3.5.5. Flows Associated with Major Wastewater Basins 3-28

CHAPTER 4 – TEMPORARY FLOW MONITORING

4.1. Background 4-1
4.1.1. Definitions 4-1
4.2. Equipment Location and Rainfall Analysis 4-2
4.2.1. Flow Meter Locations 4-2
4.2.2. Rain Gauge Locations 4-4
4.2.3. Rainfall Analysis 4-4
4.3. Flow Monitoring Analysis 4-9
4.3.1. Flow Meter Schematic 4-9
4.3.2. Dry Weather Analysis 4-10
4.3.3. Wet Weather Analysis 4-14

CHAPTER 5 – SANITARY SEWER CAPACITY EVALUATION

5.1. Modeling Software Selection 5-1
5.1.1. Background 5-1
5.1.2. Software Selection 5-1
5.2. Hydraulic Model Development 5-2
5.2.1. Purpose 5-2
5.2.2. Data Collection 5-2
5.2.3. Model Physical Attributes Development 5-3
5.2.4. Wastewater Flow Allocation 5-7
5.3. Hydraulic Model Calibration 5-9
5.3.1. Dry Weather Flow Calibration 5-9
5.3.2. Wet Weather Flow Calibration 5-12
5.4. Existing System Hydraulic Model Analysis 5-17
5.4.1. Design Criteria and Model Assumptions 5-17
5.4.2. Dry Weather System Analysis 5-20
5.4.3. 2-Year Event 5-20
5.4.4. 5-Year Event 5-21
5.4.5. Future Flow Scenarios 5-21
5.5. Future Wastewater System Analysis (No Improvements) 5-26
5.5.1. Dry Weather 5-26
5.5.2. 5-Year Event 5-26
5.6. Future Wastewater System Analysis (With Improvements) 5-30
5.6.1. Dry Weather 5-30

5.6.2. 5- Year Event 5-30
5.7. Summary of Deficiencies 5-34

CHAPTER 6 – LIFT STATION ASSESSMENTS

6.1. Background 6-1
6.2. Review of Previous Studies, Reports and Existing Data/Information . 6-2
6.3. Detailed Lift Station Evaluations 6-2
6.3.1. Lift Station Inventory Based Upon Detailed Evaluations 6-2
6.4. Dry Weather / Wet Weather Analysis 6-5
6.5. Identification of Problem Areas: Capacity, Mechanical Problems and/or Significant Structural Deterioration 6-5
6.6. Lift Station Evaluation Criteria and Ranking 6-8
6.6.1. Stations Requiring Capital Improvements (Yrs. 1-10) 6-8
6.6.2. Stations Requiring Capital Improvements (Yrs. 11-20) 6-10
6.6.3. Stations Requiring Capital Improvements (>20 Years) 6-10
6.7. TCEQ Code Compliance 6-11

CHAPTER 7 – RISK ANALYSIS – CONDITION AND HYDRAULIC CAPACITY

7.1. Risk Analysis 7-1
7.2. Risk Matrix 7-7
7.3. Collection System Evaluations 7-9
7.3.1. Aerial Crossing and Siphon Evaluations 7-9
7.3.2. Lift Station Abandonment / Trenchless Construction Techniques Evaluations 7-10
7.3.3. Mt. Carmel Backwash Filter 7-26
7.3.4. City of Beverly Hills 7-27
7.3.5. Future Interceptor Alignments, Lift Station and WWTP Locations 7-27
7.3.6. Flow Equalization Facilities Evaluation 7-38
7.3.7. Prioritization of Future Detailed Evaluations to Identify RDII 7-38

CHAPTER 8 – PROPROSED IMPROVEMENTS AND PRIORITIZATION

8.1. Prioritized Capital Improvement Program 8-1
8.2. Cost Estimating Procedures 8-1
8.2.1. General 8-1
8.2.2. Pipelines (Open Cut) 8-2
8.2.3. Pipelines (Rehabilitation) 8-3
8.2.4. Lift Stations 8-3
8.2.5. Soft Costs 8-4
8.2.6. Land Acquisition 8-4
8.3. Project Detail Descriptions 1-10 Yr. Projects (With Opinion of Probable Costs) 8-5
8.3.1. Project 1 8-6
8.3.2. Project 2 8-12
8.3.3. Project 3 8-14
8.3.4. Project 4 8-16
8.3.5. Project 5 8-22
8.3.6. Project 6 8-28
8.3.7. Project 7 8-32
8.3.8. Project 8 8-36
8.3.9. Project 9 8-40
8.3.10. Project 10 8-46
8.3.11. Project 11 8-48
8.3.12. Project 12 8-50

8.3.13. Project 13 8-52
8.3.14. Project 14 8-56
8.3.15. Project 15 8-58
8.3.16. Project 16 8-62
8.3.17. Project 17 8-64
8.3.18. Project 18 8-68
8.3.19. Project 19 8-70
8.3.20. Project 20 8-74
8.3.21. Project 21 8-76
8.3.22. Project 22 8-80
8.3.23. Project 23 8-82
8.3.24. Project 24 8-84
8.3.25. Project 25 8-86
8.3.26. Project 26 8-90
8.4. 11-20 Year Projects 8-91
8.5. Project Implementation Schedule (Sequence of CIP Construction Projects) 8-92

CHAPTER 9 – SUMMARY

9.1. Conclusions and Recommendations 9-1

Figures

Figure 1-1 Service Area Map 1-7

2-1 System Interconnection Map 2-17
2-2 SSO/RFE Map 2-18
2-3 Major Sanitary Sewer Basins 2-21
2-4 Gravity Main Map 2-22
2-5 Force Main Map 2-25
2-6 Lift Station Map 2-29
2-7 Lift Station Schematic 2-30
2-8 Aerial Crossing & Siphon Map 2-35
2-9 Barron's Branch Basin 2-37
2-10 Bosque River Basin 2-38
2-11 Brazos Basin 2-39
2-12 Carver Basin 2-40
2-13 Cottonwood Basin 2-41
2-14 Flat Creek Basin 2-42
2-15 MLK Basin 2-43
2-16 Primrose Basin 2-44
2-17 Speegleville Basin 2-45
2-18 Twin Bridges Basin 2-46
2-19 Village Lake Basin 2-47
2-20 Asset Renewal Project Areas (Not Scoped) 2-51

3-1 Wastewater Service Envelope 3-3
3-2 Future Development and Maintenance Areas 3-4
3-3 Bull Hide Basin 3-5
3-4 City of Waco Combined Population Projection Scenario 3-13
3-5 Summary of Projected Served Population 3-16
3-6 Residential Populations of Major Wastewater Basins 3-21
3-7 Commercial Populations of Major Wastewater Basins 3-22
3-8 Projected Wastewater Flows 3-27
3-9 Flows Associated with Major Wastewater Basins 3-31

4-1 Typical Sanitary Sewer Flow Sources 4-2

4-2 Temporary Monitoring Locations 4-5
4-3 Average Rainfall Intensity During the Calibration Event 4-7
4-4 Temporary Flow Meter Schematic 4-11
4-5 Example Flow Meter Data Graph 4-13
4-6 Flow Meter CW04 Response to Calibration Event 4-15
4-7 Example Flow Meter Scatter Graph 4-16

5-1 Model Data Flags 5-4
5-2 Typical Subcatchments 5-7
5-3 RDII Contributing Area Example 5-13
5-4 City of Waco 5-Year, 6-Hour Design Storm 5-17
5-5 Design Storm vs. Average of Rain Gauges for Calibration Event 5-18
5-6 Existing 2014 Dry Weather Maximum Results 5-22
5-7 Existing 2014 2-Year 24 Hour Design Storm Max Results .. 5-23
5-8 Existing 2014 5-Year 6 Hour Design Storm Max Results 5-24
5-9 Future Model Extents 5-25
5-10 Future 2040 Dry Weather Max Results-No Improvements .. 5-28
5-11 Future 2040 5-Year 6 Hour Design Storm Max Results-No Improvements 5-29
5-12 Future 2040 Dry Weather Max Results-With Improvements 5-32
5-13 Future 2040 5-Year 6 Hour Design Storm Max Results-With Improvements 5-33

7-1 Lift Station Abandonment & Gravity Extension Map 7-13
7-2 Ledgestone Lift Station Abandonment Map 7-15
7-3 Village Lake Lift Station Abandonment Map 7-16
7-4 Falcon Pointe Lift Station Abandonment Map 7-17
7-5 Bosqueville, Avon, Mammoth Site and Riverbend Ball Fields Lift Station Abandonment Map 7-18
7-6 Parkview Lift Station Abandonment Map 7-19
7-7 Village Green Lift Station Abandonment Map 7-20
7-8 Lindsey Hollow Lift Station Abandonment Map 7-21
7-9 Lincoln Park & Chicken Shack L. S. Abandonment Map 7-22
7-10 McLennan County Jail Lift Station Abandonment Map 7-23
7-11 FM 434 Lift Station Abandonment Map 7-24
7-12 Carver Lift Station Abandonment Map 7-25
7-13 Future Service Area Map 7-29
7-14 Flat Creek Interceptor Extension 7-31
7-15 Village Lake Interceptor Extension 7-32
7-16 Bull Hide Creek Interceptor Extension 7-33
7-17 Speegleville Basin Future Improvements 7-34
7-18 Speegleville Basin Potential WWTP Locations 7-37
7-19 Prioritization of Basins for Inflow & Infiltration 7-43

8-1 1-10 Year Capital Improvement Plan Projects 8-5
8-2 Project 1: 5-year, 6-hour model results – Before Project 8-7
8-3 Project 1: 5-year, 6-hour model results – After Project 8-7
8-4 Project 1: WMARSS Project No. 1 8-10
8-5 Project 2: West Bank Interceptor Rehabilitation (Part 1) 8-13
8-6 Project 4: 5-year, 6-hour model results – Before Project ... 8-18
8-7 Project 4: 5-year, 6-hour model results – After Project 8-19
8-8 Project 4: Brazos Basin Interceptor (Lower Limits) 8-20
8-9 Project 5: 5-year, 6-hour model results – Before Project 8-25
8-10 Project 5: 5-year, 6-hour model results – After Project 8-25
8-11 Project 5: Village Lake Hydraulic Capacity Improvements.. 8-26
8-12 Project 6: 5-year, 6-hour model results – Before Project 8-29

8-13 Project 6: 5-year, 6-hour model results – After Project 8-29
8-14 Project 6: Reroute Church Road Lift Station Flows..... 8-31
8-15 Project 7: 5-year, 6-hour model results – Before Project 8-33
8-16 Project 7: 5-year, 6-hour model results – After Project 8-33
8-17 Project 7: Brazos Basin Interceptor (Upper Limits) 8-35
8-18 Project 8: 5-year, 6-hour model results – Before Project 8-37
8-19 Project 8: 5-year, 6-hour model results – After Project 8-38
8-20 Project 8: WMARSS Project No. 2 8-39
8-21 Project 8: WMARSS Project No. 2 8-39
8-22 Project 9: 5-year, 6-hour model results – Before Project 8-41
8-23 Project 9: 5-year, 6-hour model results – After Project 8-41
8-24 Project 9: Church Road Lift Station Added Capacity 8-44
8-25 Project 11: West Bank Interceptor Rehabilitation (Part 2).... 8-49
8-26 Project 12: WMARSS Project No. 3 8-51
8-27 Project 13: 5-year, 6-hour model results – Before Project: . 8-54
8-28 Project 13: 5-year, 6-hour model results – After Project 8-54
8-29 Project 13: Reroute of Wooded Acres Lift Station Flows 8-55
8-30 Project 15: 5-year, 6-hour model results – Before Project ... 8-60
8-31 Project 15: 5-year, 6-hour model results – After Project 8-60
8-32 Project 15: Added Capacity TSTC L.S. And F.M. Improve. . 8-61
8-33 Project 16: Abandon Lindsey Hollow Lift Station 8-63
8-34 Project 17: 5-year, 6-hour model results – Before Project ... 8-64
8-35 Project 17: 5-year, 6-hour model results – After Project 8-65
8-36 Project 17: Barron's Branch 8-66
8-37 Project 18: WMARSS Project No. 4 8-69
8-38 Project 19: 5-year, 6-hour model results – Before Project ... 8-71
8-39 Project 19: 5-year, 6-hour model results – After Project 8-71
8-40 Project 19: Cottonwood Basin Added Capacity 8-72
8-41 Project 21: Abandon McLennan County Jail Lift Station 8-78
8-42 Project 23: WMARSS Project No. 5 8-83
8-43 Project 24: 5-year, 6-hour model results – Before Project ... 8-84
8-44 Project 24: 5-year, 6-hour model results – After Project 8-85
8-45 Project 24: Gravity Line Upstream of Church Road L.S..... 8-85
8-46 Project 25: 5-year, 6-hour model results – Before Project ... 8-87
8-47 Project 25: 5-year, 6-hour model results – After Project 8-88
8-48 Project 25: Reroute Village Green And Park Lake L.S's..... 8-89
8-49 11-20 Year Capital Improvement Plan Projects 8-93
8-50 Project Implementation Schedule..... 8-94

9-1 CIP Cost Allocation by Project Type 9-3

Tables

Table 2-1 Summary of Previous Studies / Reports..... 2-1
2-2 Historical WMARSS Metered Flow Data..... 2-2
2-3 Historical WMARSS March 19-20, 2012 Rainfall Event Data 2-3
2-4 Pipe Summary..... 2-23
2-5 Gravity Main Summary..... 2-23
2-6 Force Main Summary..... 2-27
2-7 Manhole Age Summary (COW GIS) 2-27
2-8 Lift Station Summary..... 2-31
2-9 Asset Renewal Project Ranking..... 2-49
2-10 Lift Station Condition Rating and Capacity (Per City Staff).. 2-54
2-11 Lift Station Summary..... 2-55

3-1 Historical Population..... 3-7
3-2 "2011 Regional Water Plan" Population Projections..... 3-8
3-3 Comparison of Population Projections..... 3-15

3-4 Projected Population 3-16
3-5 Highway 84 Corridor Growth Projections by TAZ 3-17
3-6 China Spring Corridor Growth Projections by TAZ 3-17
3-7 Bull Hide Basin Growth Projections by TAZ 3-18
3-8 Summary of Projected Served Residential Population by Major Wastewater Basin 3-19
3-9 Summary of Projected Served Commercial Population by Major Wastewater Basin 3-19
3-10 Large Wastewater Customers 3-25
3-11 Historical Annual Average Wastewater Flows 3-26
3-12 Projected Wastewater Flows 3-26
3-13 Summary of Projected Wastewater Flows by Major Wastewater Basin (2015) 3-29
3-14 Summary of Projected Wastewater Flows by Major Wastewater Basin (2020) 3-29
3-15 Summary of Projected Wastewater Flows by Major Wastewater Basin (2030) 3-30
3-16 Summary of Projected Wastewater Flows by Major Wastewater Basin (2040) 3-30

4-1 Flow Meter Locations 4-3
4-2 Rain Gauge Locations 4-4
4-3 Rainfall Data for Monitoring Period 4-9

5-1 Modeled Pipe Roughness Ranges 5-5
5-2 Final Metershed GPCD 5-10
5-3 Dry Weather Flow Calibration Summary 5-11
5-4 Wet Weather Flow Calibration 5-14
5-5 Wet Weather Flow Verification – April 6, 2014 5-15
5-6 Wet Weather Flow Verification – May 8, 2014 5-16
5-7 Pipe Capacity Summary for Existing Conditions 5-21
5-8 Pipe Capacity Summary for Future Conditions No Improvements 5-30
5-9 Pipe Capacity Summary for Future Conditions With Improvements 5-31

6-1 Lift Station Inventory 6-3
6-2 Lift Station Condition Rating and Capacity 6-6
6-3 Condition Rating and Capacity Risk Matrix 6-7

7-1 Basic Risk Rating Matrix 7-2
7-2 Temporary Flow Meter Locations 7-39
7-3 Prioritization of Basins for Inflow & Infiltration 7-40

8-1 Pipeline Costs (Open Cut) 8-2
8-2 Pipeline Costs (Rehabilitation) 8-3
8-3 Lift Station Costs 8-4

9-1 City of Waco Collection System 1 to 10-Year Capital Improvement Program Summary 9-2

Appendices

Appendix A – City Identified Projects Form
Appendix B – Population Estimates (TAZ)
Appendix C – Risk Matrix
Appendix D – 1-10 Year CIP Map and One-Page CIP Project Forms
Appendix E – Electronic Copies

THIS PAGE IS INTENTIONALLY LEFT BLANK

EXECUTIVE SUMMARY

The City of Waco retained the Team of Walker Partners, HDR, rjn group and Burgess & Niple to develop a Wastewater Master Plan for the city's wastewater collection system. Waco's last comprehensive Wastewater Mater Plan was conducted in 1975. In 2000, as part of the Comprehensive Plan 2000, three broad-based wastewater planning recommendations were presented as part of the overall Comprehensive Plan; however, neither the objective nor the intent of that effort was to identify inadequacies or risks in the existing wastewater system. Since the time that the above mentioned studies were completed, the City's wastewater collection system has both aged and grown in size and complexity.

Significant effort was spent in order to ascertain the actual wastewater flows within the collection system during rainfall events. Old sanitary sewer systems are not watertight, and during heavy rains storm water enters the sanitary sewers, loads the pipes, and causes sewage spills in the creeks and rivers. The work included the temporary metering of the sewer system used to calibrate the computer model with the "real world" data. This metered flow data enables the City staff to better understand their existing system and better manage the day-to-day operations. The Master Plan evaluates, in detail, the capacity of the existing system, the structural integrity and projected longevity of the system, and the consequences of failure of the components of the existing system. This effort will enable city planners and engineers to manage budgets, growth, and capital improvement projects for the next two decades.

The Wastewater Collection System Master Plan report has been prepared to provide the City of Waco a road map that will serve as a guide for short-term and long-term improvements to the wastewater system infrastructure. The plan will provide the City with a strategy to not only preserve previous investments in the existing sanitary sewerage infrastructure, but to plan for the future needs of a growing City. The key objectives in preparing this roadmap are summarized as follows:

Capture, document, and map historical and institutional knowledge of the system

The City's collection system consists of more than 700 miles of gravity sewer and force main pipes that are located within 12 major wastewater basins. The City's wastewater flows enter the Waco Metropolitan Area Regional Sewerage System (WMARSS) collection system where the flows are ultimately treated at one of two wastewater treatment plants that are owned and operated by the WMARSS. A series of fifty-eight City-owned and operated lift stations are sited at locations where the wastewater needs to be pumped to a higher elevation so that gravity flow can resume to the outfall of the system. These existing lift stations vary in size. Approximately fifty-one stations are deemed to be small to medium in size while seven stations are regarded to be large in size.

A series of meetings were held with City staff to ensure that existing problem areas were identified, that operational challenges were properly characterized and that proper connectivity within the collection system was furnished. Historically, sanitary sewer overflows have been reported by Water Utilities staff in locations throughout the system during wet weather events.

Develop comprehensive and accurate population and flow projections

The population within the City of Waco wastewater service area is projected to grow by approximately 40,000 people in the next 25 years. An annual citywide growth rate of 1.07% was used to plan ahead for this future population. The projections predict growth to be greater than 1.07% per year in some areas to be served by public sewer service and less than 1.07% per year in other areas to be served by public sewer service. The growth projections utilized were developed in concert with the Comprehensive Plan. The projections anticipate growth to continue at this level to the 2040 planning period to contain a population of 171,886.

The comprehensive analysis of the projected populations provides the basis for future wastewater flows. Projected wastewater flows are dependent on both the existing population and predicted development served by the upstream collection system which allows for the correct sizing and locating of system infrastructure. Future average daily wastewater loads were developed by applying per-capita loadings to the growth in population for the 2015, 2020, 2030 and 2040 planning periods. The peak wet weather to average day peaking factors were determined utilizing the data obtained as part of the temporary flow monitoring efforts for a 5-year, 6-hour design storm. The City's projected peak wet weather wastewater flow is projected to increase by 22.1 MGD over the next 25 years from 118.6 MGD in 2015 to 140.7 MGD in 2040.

Analyze the existing sanitary sewer system

Hydraulic analyses were conducted using InfoWorks CS hydraulic modeling software package to identify deficiencies in the existing collection system. A series of analyses were evaluated including: existing system dry weather and wet weather events, as well as future dry weather and wet weather events. The analyses identified and predicted deficiencies and associated risks within the present system. Solutions were identified in order to optimize future improvements that will aid and support well planned growth. The modeling results indicated that no overflows occur during 2014 dry weather system conditions. The modeling results did indicate nine overflow locations during a 2014 5-Yr, 6-Hr storm event which results in spillage of 1 million gallons into Lake Waco and Lake Brazos. The temporary flow monitoring indicated that multiple areas within the system experience very high levels of inflow and infiltration during wet weather events.

Detailed lift station evaluations were performed on the twenty-one most important stations within the system. Approximately 60% of the

fifty-eight stations that currently exist within the system are 30 years in age or older. Many of the existing stations are located near or adjacent to Lake Waco. It is recommended that the City limit and/or reduce the number of lift stations where possible because of the cost of operating and maintaining the facilities and due to the consequence of failures.

Protect the City's water supply

It is essential to protect Lake Waco and the Brazos River from the detrimental environmental effects of wastewater spills and overflows. These types of spills jeopardize the safety of Waco's public drinking water, degrade the recreational enjoyment of the lake and rivers, and make the City vulnerable to enforcement actions from the TCEQ and the EPA.

Lift station routing alternatives were developed to allow the City to formulate strategies that will facilitate the abandonment of various lift stations within the wastewater collection system to help reduce the current environmental risks.

Develop a prioritized Capital Improvement Program

The Capital Improvement Program seeks to improve the existing wastewater collection system and accommodate projected wastewater flows through 2040. Combinations of improvements were evaluated at various locations in order to establish the most appropriate approaches for implementation. These evaluations included considerations to increase system reliability, to simplify system operations, to handle peak wet weather flows, to reduce sanitary sewer overflows, and to assist staff in the operation and management of the wastewater collection system. The projects will move the City towards a more reliable and efficient wastewater system. It is understood that a Capital Improvement Program that doesn't assist the Water Utilities staff in operating and managing their system is not considered to be a good plan. The program will also assist staff in planning and prioritizing future wastewater projects to accommodate redevelopment of existing urbanized areas; to promote longevity and redundancy of the current sanitary sewer system; to rehabilitate sections of pipe that have outlived their design life; and to maximize the return on investment for each improvement project.

The Capital Improvement Program summary is provided in Chapter 9. The program was developed to ensure the wastewater collection system will effectively and efficiently convey collection system flows. Improvements were organize into five different project types to include: WMARSS, Lift Stations, Gravity Sewer/Force Mains, Rehabilitation, and Asset Renewal. Each of the project types were phased into a 10 year planning period in order to make sure that the right improvements are built at the right time. The recommended improvements will serve as a basis for the design, construction, and financing of facilities to meet the identified need. The total cost of the 10-Year Capital Improvement Program is $245,000,000.00.

THIS PAGE IS INTENTIONALLY LEFT BLANK

CHAPTER 1 - INTRODUCTION

The City of Waco is a growing community. Waco's US Census Bureau population in 2013 was approximately 129,030. The City of Waco operates and maintains a wastewater collection system providing wastewater service to approximately 37,300 customers throughout the greater City of Waco area. The City of Waco additionally provides wastewater service to the Texas State Technical College campus, the City of Beverly Hills, and the City of McGregor Executive Airport.

For 2013-2014, the Water Utilities Department employed approximately 46 personnel to operate, maintain, and manage the City's water and wastewater utilities. Over the last 3 years, the Water Utilities Department total water and wastewater operating expenditures have been between $12 million to $13 million per year. As part of this annual budget, the City has spent approximately $1.6 million per year for wastewater rehabilitation, replacement, and expansion projects. Historically, this program has been driven by available annual budget funding and the associated prioritization of the most crucial needs in the system.

1.1. Purpose (Scope of Work)

The City of Waco retained the Team of Walker Partners, HDR, rjn group, and Burgess & Niple to evaluate the City of Waco collection system and develop a Capital Improvements Plan. Waco's collection system consists of more than 700 miles of gravity sewer and force main pipes and 58 lift stations.

The purpose of this planning effort was to analyze and make recommendations to the City regarding its existing wastewater collection system and identify crucial improvements. The evaluation brought forth a three-fold objective.

- **Meet Texas Commission on Environmental Quality (TCEQ) requirements and other design criteria**. The TCEQ requirements for wastewater systems are provided within the Texas Administrative Code (TAC), Chapter 217, Design Criteria for Domestic Wastewater Systems and includes sewer line design and lift station capacity.
- **Improve the operation of the existing system**. The operation and maintenance of the City's existing aging wastewater system assets was a continual focus.
- **Provide the City a roadmap for future growth and development.** Future growth was accommodated for in an efficient and cost effective manner.

During the course of the master planning effort, City of Waco staff expended considerable time and effort working alongside the Project Team. Various Water Utilities personnel provided extremely valuable operational data as well as institutional and historical knowledge regarding the current state of the collection system. The Project Team has relied upon this information extensively as part of our evaluation and the formulation of the Capital Improvement Program. The overall integrity of the master plan effort is largely dependent upon the accurateness of this data. Significant effort was put forth by the Project Team in order to validate and confirm a large amount of the information that was provided by Water Utilities and Engineering personnel. The Team met with these employees in a series of meetings to narrow the recommendations presented herein, with the goal of including only those recommendations that are judged necessary to maintain the performance of the existing interceptor system at acceptable levels.

1.2. Wastewater Treatment and the Waco Metropolitan Area Regional Sewerage System (WMARSS)

The City of Waco has provided public wastewater service for about 90 years. The City constructed and began operation of its first Wastewater Treatment Plant (and corresponding collection system) on the south side of the City in 1925. The City continued to operate and maintain both the treatment and collection systems through 1970 at which time the Brazos River Authority (BRA) acquired the Treatment Plant from the City. During the early 1970's, the BRA administered most of the design and construction projects that currently comprise the existing WMARSS interceptor system.

In February 2004, the City of Waco and other municipalities in the greater Waco area formed a coalition and reacquired the Wastewater Treatment Plant and the corresponding BRA collection system thus forming the Waco Metropolitan Area Regional Sewerage System (WMARSS). This was done in order to ensure that future wastewater is used effectively and that rates remain affordable for the citizens of Waco and the surrounding communities. The City of Waco is currently an equity owner of WMARSS which is a joint wastewater treatment effort by the Cities of Bellmead, Hewitt, Lacy Lakeview, Lorena, Robinson, Waco, and Woodway. By sharing centralized regional service facilities, the individual Cities are not required to operate independent wastewater treatment plants. Therefore, each of the various City's entire wastewater collection system flows are conveyed to WMARSS for treatment purposes so that each City is not required to operate an independent wastewater treatment facility.

In 2004, the WMARSS quasi-governmental board was formed to administer the joint wastewater effort. Among these tasks is the operation and maintenance of the wastewater interceptor system and treatment facilities. The current WMARSS wastewater collection

system is comprised of six major wastewater interceptors (East Bank, Lacy Lakeview, Bellmead, Cottonwood, Flat Creek, and Bull Hide Creek), five lift stations (Carver, LaSalle, Main, Transfer, and Woodway) and two wastewater treatment plants (Central and Bull Hide Creek). The maintenance and operation of the system's gravity interceptors, lift stations, and force mains requires ongoing capital rehabilitation and improvement.

Historically, the WMARSS Central Wastewater Treatment Plant operated as the only WMARSS wastewater treatment plant. The current treatment capacity of the Central Wastewater Treatment Plant is 45.0 MGD and no expansion is planned at this time for the future. A second wastewater facility (the Bull Hide Creek Wastewater Treatment Plant) was completed in the winter of 2011. This plant increased the overall system treatment capacity by an additional 1.5 MGD. Therefore, the Bull Hide Creek WWTP provides WMARSS a total permitted treatment capacity of 46.5 MGD (Design Flow). The City's current ownership interest gives Waco 35.0 MGD of the total 46.5 MGD WMARSS capacity. It is understood that WMARSS is currently at approximately 66% of its total permitted design flow capacity. The TCEQ permit requirements stipulate that planning for additional capacity must be undertaken when the existing flows for three consecutive months reach 75% of the permitted capacity based on annual average flow. At 90% of the permitted capacity, construction of additional capacity should be underway. It is estimated that construction of future additional WMARSS treatment capacity upgrades will not be necessary for the next decade. Therefore, WMARSS (and the City of Waco) currently possess sufficient wastewater treatment capacity for its short-term goals. However, WMARSS does not have available capacity to adequately handle peak flows within the collection system. Providing additional system capacity for peak flows will correspondingly require additional wet weather treatment capacity or the construction of peak flow storage basins at the treatment plant locations.

WMARSS completed its last facilities expansion program from 2008-2011. The program included four major projects: improvements at the Central WWTP, the Flat Creek Interceptor, the Bull Hide Creek Interceptor and the Bull Hide Creek WWTP. In 2013, Walker Partners and Burgess & Niple assisted WMARSS in developing a 3-10 Yr. Capital Improvement Plan for the regional system's collection system. The overall costs associated with this CIP in order to rehabilitate or replace considerable segments of the system's aged infrastructure are substantial. An in-depth evaluation of Waco's future costs as being a member of WMARSS was not a part of this master planning effort; however, the projects and associated costs of the 2013 WMARSS Large Diameter Interceptor Improvements Report 3-10 Yr. CIP Projects are provided within the City of Waco Capital Improvement Program included herein for the City's aid and use.

For the fiscal year ending September 30, 2014, the City of Waco's ownership equity percentage accounted for 75.272% of WMARSS;

therefore, the City will be required to participate at this ownership percentage for each required capital improvement.

1.3. Master Plan Organization

This Master Plan Report is organized into the following chapters:

CHAPTER 1 – INTRODUCTION
Outlines the background, purpose, report organization, and study area delineation.

CHAPTER 2 – HISTORICAL / INSTITUTIONAL KNOWLEDGE
Provides the background and description of the existing wastewater collection system components and the existing major wastewater basins. 25 years of Waco's investment in studies and reports were revisited as part of the master planning effort.

Details data compiled in validation of 51 problem areas of various deficient gravity sewer segments as well as force mains and lift stations that are recognized as recurrent high priority problem locations identified by Water Utilities staff.

Presents discussion of the City's 2009 Sanitary Sewer Overflow Initiative Program with the TCEQ as well as the need for the City to continue implementation of a cleaning and inspection program and a fats, oils, and grease (FOG) program.

CHAPTER 3 – SYSTEM PLANNING, POPULATION, AND FLOW PROJECTIONS
Presents background information for land use as well as current and future wastewater service areas.

Presents historical, current, and projected population estimates for the areas served by public wastewater service.

Describes historical and current wastewater flows and their use in projecting future wastewater flows. Provides a description of average daily flow and peak wet weather flow projections within each of the major wastewater basins.

CHAPTER 4 – TEMPORARY FLOW MONITORING
Provides temporary flow monitoring (flow meters and rain gauge) background for the continuous March 1 – May 31, 2014 monitoring period and the resultant dry weather and wet weather analysis.

CHAPTER 5 – SANITARY SEWER CAPACITY EVALUATION
Outlines the development of the hydraulic model and presents the hydraulic model calibration performed in order to accurately analyze the existing collection system.

Presents the existing dry weather and wet weather hydraulic analyses as well as the future dry weather and wet weather hydraulic analyses. Model simulations were run to provide system results if the identified improvements to the collection system were completed or if they were not completed.

CHAPTER 6 – LIFT STATION ASSESSMENTS
Provides evaluation results for 21 of the largest (most significant) lift stations within the collection system and prioritizes (ranks) the stations requiring capital improvements.

CHAPTER 7 – RISK ANALYSIS – CONDITION AND HYDRAULIC CAPACITY
Presents the risk analysis performed regarding the structural and hydraulic deficiencies within the interceptor system.

Recommends an asset renewal strategy to improve the overall condition of the existing gravity sewers from a structural standpoint.

Provides collection system evaluations to abandon lift stations, siphons, and aerial crossings. Provides a road map for future (2040) interceptor alignments and lift station and WWTP locations.

CHAPTER 8 – PROPOSED IMPROVEMENTS AND PRIORITIZATION
Details the recommendations for system improvements within the Capital Improvement Program. Detailed project descriptions and Opinion of Probable Costs are provided for each 1-10 Year Capital Improvement Program project to serve existing and future growth.

Provides a Project Implementation Schedule for the recommended 1-10 Year improvements. An implementation plan is provided to assist the City in fully understanding which projects must be completed prior to the initiation of subsequent projects.

Presents a listing of future 11-20 Year projects to be considered as growth warrants.

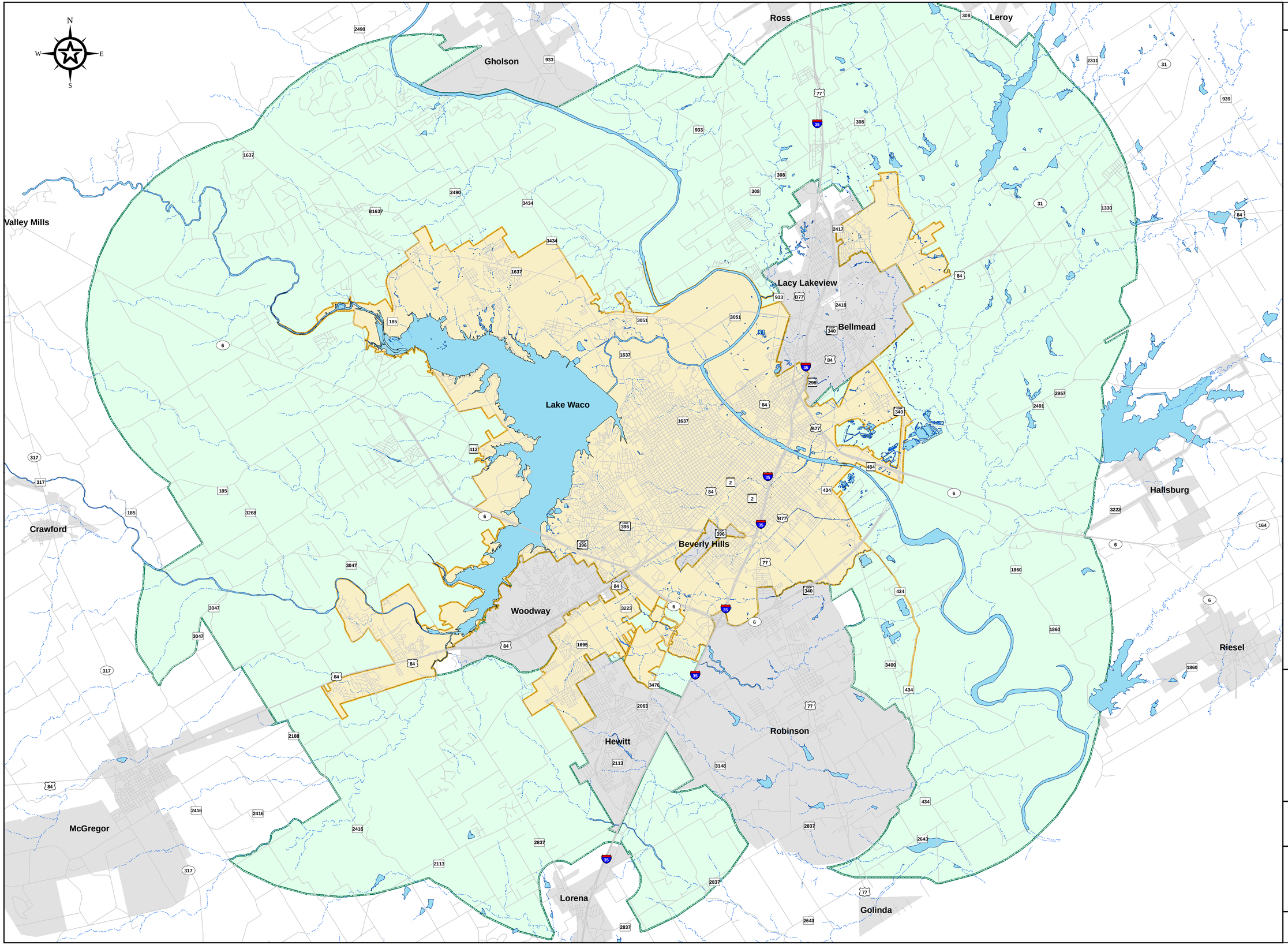
CHAPTER 9 – SUMMARY
Presents the summary of recommendations for the 1-10 Year Capital Improvement Program that allows the City to prudently plan and manage its future wastewater collection system.

1.4. Study Area Delineation

The wastewater service study area for the sanitary sewer system master planning effort is shown in Figure 1-1. This figure also shows the boundaries of the municipalities adjacent to the City including the Cities of Bellmead, Hewitt, Lacy Lakeview, Lorena, Robinson, and Woodway.

The City of Waco's existing corporate limits cover just over 100 square miles. A majority of the area within Waco's corporate limits is provided service by the City's public wastewater collection system. Waco's existing ETJ limits cover approximately 355 square miles. Very little area outside of Waco's City limits and inside the City's ETJ is provided with public sewer service.

The City of Waco holds a CCN (Certificate of Convenience and Necessity) for its wastewater system. The benefit of the CCN is that it provides the City the exclusive, monopoly right to provide service within that geographical area. Basically, a CCN helps to safeguard investments in infrastructure by creating a measure of protection to provide wastewater service to an existing, growing, or future customer base. However, the CCN also obligates the CCN holder to provide service when requested by a new or existing customer located within the service area. The TCEQ holds enforcement authority against CCN holders who are not meeting their regulatory obligation to provide continuous and adequate service.



LEGEND

- Waco City Limits
- Waco ETJ Limit
- City Limits of Surrounding Municipalities
- Surface Water
- Stream

CITY OF WACO

0 3000 6000 12000

GRAPHIC SCALE (FEET)

Figure 1-1: Service Area Map

G:\GIS\Projects\1-02231\Maps\Overall System Map 11x17.mxd

CHAPTER 2 – HISTORICAL / INSTITUTIONAL KNOWLEDGE

2.1. Review Previous Studies, Reports and Existing Data/Information

Available existing reports and studies regarding the collection system were gathered and summarized. These sets of data and reports span the timeframe from 1992 to the present and likely represent only a small portion of the effort expended by dedicated COW staff to operate and maintain the wastewater system in its current condition.

2.1.1. Background

The background information reviewed spans the period from 1992 to the present.

A large volume of historical construction and operational data was reviewed as part of this effort. Much of the information over the years has been stored in a decentralized fashion. Both City of Waco staff and Team members attempted to locate a copy of the 1975 URS Wastewater Master Plan, but no copy of the report was located. Table 2-1 shows the previous studies / reports that were reviewed as part of our data mining efforts.

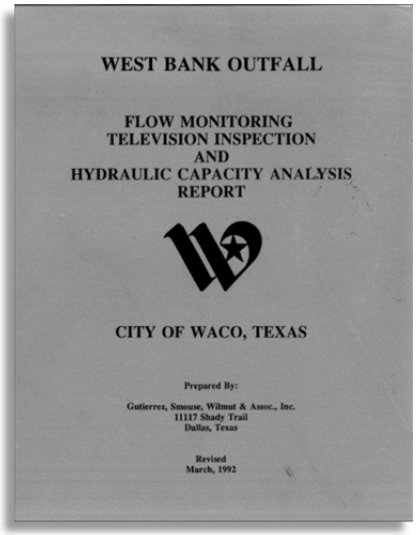
Table 2-1: Summary of Previous Studies / Reports

Date	Title	Author
Mar 1992	West Bank Outfall – Flow Monitoring, Television Inspection and Hydraulic Capacity Analysis	GSW, Inc.
Mar 1992	Wilson Creek Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
Jan 1994	Landon Branch Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
Jan 1994	Barron's Branch Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
Dec 1994	North Waco Creek Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
Oct 1997	Lower Waco Creek Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
Nov 1997	Upper Waco Creek Drainage Basin Infiltration and Inflow Reduction Project Report	GSW, Inc.
May 1998	Flow Monitoring and Hydraulic Modeling of Major Collection Lines Serving the West Bank Outfall	GSW, Inc.
Jan 2001	Comprehensive Plan 2000	Dunkin, Sefko & Associates, Inc. and The Wallace Group, Inc.
May 2003	Diagnosis of Sanitary Sewer System	InfraMetrix, LLC
Oct 2003	Flow Monitoring Study (WMARSS) for City of Waco	GSWW, Inc.
May 2005	Hydraulic Modeling of Major Collection Lines Serving the East and West Bank Outfalls	GSWW, Inc.

Date	Title	Author
Jun 2005	West Basin Permanent Flow Monitoring Plan – Technical Memorandum	GSWW, Inc.
Aug 2006	Landon Branch and Barron's Branch Recommended Collection System Rehabilitation Plan	GSWW, Inc.
Aug 2008	Landon's and Barron's Branch Wastewater Line Replacement Preliminary Engineering Report	LAN, Inc.
Dec 2009	Wastewater Master Plan for Bull Hide Creek Basin and Warren Road Lift Station	Walker Partners
Mar 2010	Tinkers and Wooded Acres Basins Sanitary Sewer System Evaluation Study – Flow Monitoring Site Selection Technical Memorandum	GSWW, Inc.
Jun 2010	Tinkers and Wooded Acres Basin Wastewater Inflow and Infiltration Study Report	GSWW, Inc.
Jul 2010	Tinker's Branch and Wooded Acres Recommended Collection System Rehabilitation Plan	GSWW, Inc.
Feb 2013	Large Diameter Interceptor Improvements Report for WMARSS	Walker Partners / Burgess & Niple

2.1.2. Previous Studies / Reports

The listing of reports below is not considered to be all inclusive, it is strictly a listing of all available reports provided by the City of Waco staff.


WEST BANK OUTFALL

FLOW MONITORING
TELEVISION INSPECTION
AND
HYDRAULIC CAPACITY ANALYSIS
REPORT

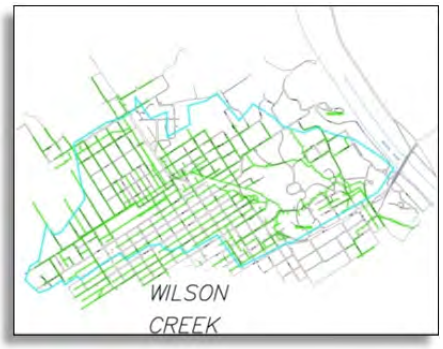
CITY OF WACO, TEXAS

Prepared By:

Gutierrez, Smouse, Wilmut & Assoc., Inc.
11117 Shady Trail
Dallas, Texas

Revised
March, 1992

Mar 1992: GSW, Inc. ***West Bank Outfall – Flow Monitoring, Television Inspection and Hydraulic Capacity Analysis***
This report outlined the results of flow metering and performed a hydraulic capacity analysis for the existing condition of the West Bank Outfall and a projected fifty percent (50%) reduction in I/I. A hydraulic model using HYDRA 6.0 was used to evaluate the West Bank Interceptor and concluded that it was subjected to wastewater and I/I volumes in substantial excess of its gravity flow capacity during wet weather conditions. **The total wastewater flow was measured at 6.86 mgd in dry weather flow and a projected peak wet weather flow (2 yr/24 hr rainfall) of 45.4 mgd. This equates to a 6.6 peaking factor.** The data indicated that 100% of the West Bank Interceptor operates in a surcharged condition under wet weather flow (2 yr/24 hr rainfall) conditions. The model also indicated that approximately 56%, or nearly 11,100 feet of the West Bank Interceptor surcharges to the extent that the hydraulic grade line for that given segment of pipe reaches the ground elevation; indicating overflow conditions. The report concluded that a 33% reduction in peak flow results in a potential 80% reduction in surcharged conditions and a potential 85% reduction in overflows. The report recommended proceeding with SSES reports for all studied basins and the associated improvements identified within those reports.



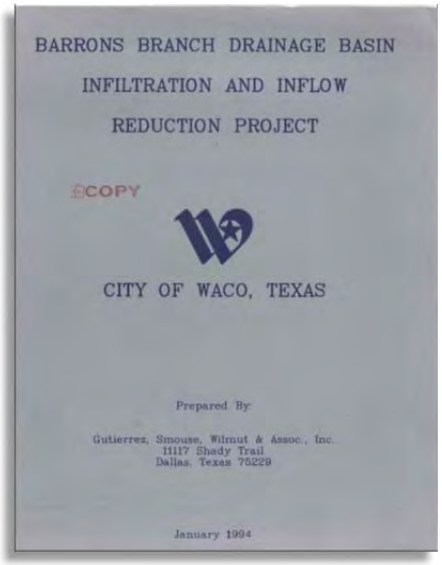
The report concluded that the Wilson Creek Basin is severely overloaded during wet weather events. Subsequent to this study, the City of Waco combined the Wilson Creek Basin with the Barron's Branch Basin. The resulting larger basin is currently named the Barron's Branch Basin.

Mar 1992: GSW, Inc. ***Wilson Creek Drainage Basin Infiltration and Inflow Reduction Project Report***

This report outlined the smoke testing of approximately 164,000 linear feet of sewer line and the inspection of 366 manholes in the Wilson Creek Drainage Basin which identified 282 sources of I/I contributing 1,603 gpm (2.31 mgd) to the system. Of the 1,603 gpm identified, approximately 601 gpm (37%) was from sources located on service lines on private property. Flow monitoring was used and resulted in a dry weather flow of approximately 0.90 mgd and a wet weather flow (2 yr/24 hr rainfall) of 5.8 mgd. **This equates to a 6.4 peaking factor.** The report concluded that the wastewater collection system is severely overloaded during wet weather events and an overflow condition exists in a manhole near the Methodist Home. The report recommended to continue studying as well as attempt to eliminate 1,603 gpm of I/I by various forms of rehabilitation on structurally deficient segments at an estimated 1992 cost of $285,700.00.

Jan 1994: GSW, Inc. ***Landon Branch Drainage Basin Infiltration and Inflow Reduction Project***

This report outlined the smoke testing of 168,224 linear feet of sewer line and the inspection of 486 manholes in the Landon Branch Basin which identified 261 sources of I/I contributing approximately 972 gpm (1.40 mgd) to the system. Of the 972 gpm identified, approximately 230 gpm (24%) was from sources located on service lines on private property. The 10-inch interceptor located directly upstream of the Landon Branch Lift Station was identified as having inadequate capacity. **The report concluded that the wastewater collection system is severely overloaded during wet weather.** The report recommended to continue studying as well as attempt to eliminate 972 gpm of I/I by various forms of rehabilitation on structurally deficient segments at an estimated 1994 cost of $289,450.00.


BARRONS BRANCH DRAINAGE BASIN
INFILTRATION AND INFLOW
REDUCTION PROJECT

COPY

CITY OF WACO, TEXAS

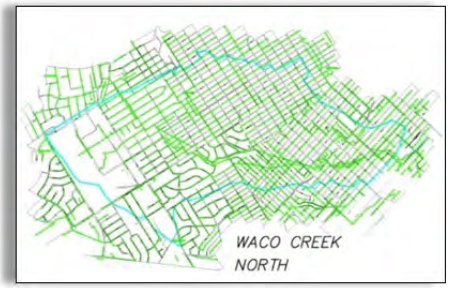
Prepared By:

Gutierrez, Smouse, Wilmut & Assoc., Inc.
11117 Shady Trail
Dallas, Texas 75229

January 1994

Jan 1994: GSW, Inc. ***Barron's Branch Drainage Basin Infiltration and Inflow Reduction Project***

This report outlined the smoke testing of 253,658 linear feet of sewer line and the inspection of 604 manholes in the Barron's Branch Basin which identified 584 sources of I/I contributing approximately 2,877 gpm (4.14 mgd) to the system. Of the 2,877 gpm identified, approximately 1,065 gpm (37%) was from sources located on service lines on private property. Flow monitoring and hydraulic modeling was used to evaluate the Barron's Branch Interceptor. **The report concluded that the wastewater collection system is severely overloaded during wet weather and even with a 50% reduction in I/I, surcharging/overflow potential still existed within the basin.** The report recommended continued study as well as attempting to eliminate 2,877 gpm of I/I by various forms of rehabilitation on structurally deficient segments at an estimated 1994 cost of $1,023,650.00.



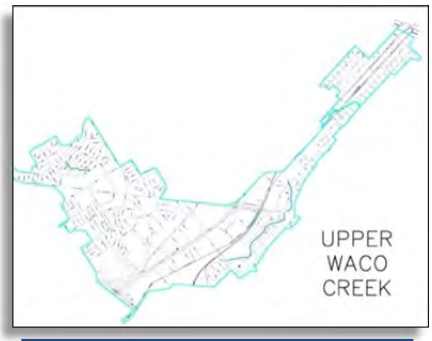
Dec 1994: GSW, Inc. ***North Waco Creek Drainage Basin Infiltration and Inflow Reduction Project***

This report outlined the smoke testing of 366,132 linear feet of sewer line and the inspection of 862 manholes in the North Waco Creek Basin which identified 567 sources of I/I contributing approximately 1,578 gpm (2.27 mgd) of peak 2-hour I/I. Of the 1,578 gpm identified, approximately 595 gpm (37.7%) was from sources located on service lines on private property. **A hydraulic model (HYDRA 6.0) was used to evaluate the major sewer lines within the North Waco Creek Drainage Basin and resulted in a dry weather flow of approximately 1.20 mgd and a wet weather flow (2 yr/24 hr rainfall) of 6.22 mgd. This equates to a 5.2 peaking factor.** The report concluded that the wastewater collection system is severely overloaded during wet weather. The report recommended continued study as well as attempting to eliminate 1,578 gpm of peak I/I by various forms of rehabilitation on structurally deficient segments.

The Lower Waco Creek Report concluded that the wastewater collection system is severely overloaded during wet weather events.

Oct 1997: GSW, Inc. ***Lower Waco Creek Drainage Basin Inflow and Infiltration Reduction Project***

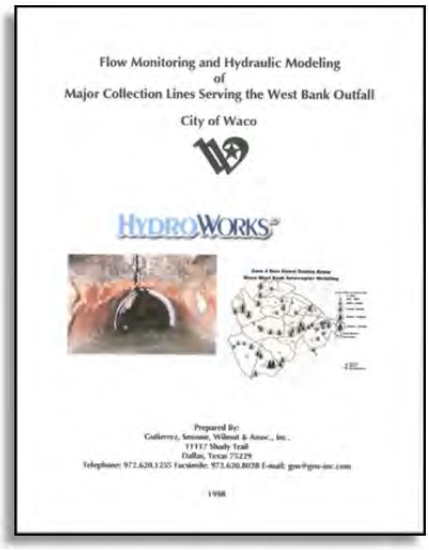
This report outlined the smoke testing of 236,776 linear feet of sewer line and the inspection of 626 manholes in the Lower Waco Creek Basin which identified 1,029 defects contributing approximately 2,031 gpm (2.93 mgd) of potential I/I. **Of the 2,031 gpm identified, approximately 561.5 gpm (29%) was from sources located on service lines on private property.** The report concluded that the wastewater collection system is severely overloaded during wet weather. The report recommended attempting to eliminate 2,031 gpm of potential I/I by various forms of rehabilitation on structurally deficient segments.



The Upper Waco Creek Report estimated that a 6.4 peaking factor was predicted during 2 yr/24 hr rainfall events.

Nov 1997: GSW, Inc. ***Upper Waco Creek Drainage Basin Inflow and Infiltration Reduction Project***

This report outlined the smoke testing of 331,561 linear feet of sewer line and the inspection of 792 manholes in the Upper Waco Creek Basin which identified approximately 1,380 gpm (1.99 mgd) of peak I/I potential. Of the 1,380 gpm identified, approximately 513.5 gpm (37.2%) was from sources located on service lines on private property. A hydraulic model using HYDRA 6.0 was used to evaluate the major sewer lines within the Upper Waco Creek Drainage Basin and resulted in a dry weather flow of approximately 2.82 mgd and a wet weather flow (2 yr/24 hr rainfall) of 18.02 mgd. **This equates to a 6.4 peaking factor. The report concluded that the wastewater collection system is severely overloaded during wet weather.** The report recommended attempting to eliminate 1,380 gpm of potential I/I by various forms of rehabilitation on structurally deficient segments at an estimated 1997 cost of $352,850.00. **The report also recommended the addition of approximately 2,842 linear feet of relief sewer lines.**



The 1998 Study recommended rerouting the Wooded Acres lift station flows away from the West Bank Outfall and to the Cottonwood Basin. This recommendation was implemented and completed in 1999.

It is noted that the West Bank Interceptor is overloaded and that the overloading contributes to problems in the Lindsey Hollow, Barron's Branch and Waco Creek major basins and that relieving the West Bank Interceptor would be the first step in alleviating the overflow problems in the older parts of the Waco sewer system.

May 1998: GSW, Inc. *Flow Monitoring and Hydraulic Modeling of Major Collection Lines Serving the West Bank Outfall*

This report outlined extensive flow monitoring performed on trunk mains and interceptors serving the West Bank Interceptor as well as the progress made within the sewer system by completing the recommendations made in previous studies and reports. Twenty temporary flow meters and five temporary rainfall gauges were installed within the basins contributing flow to the West Bank Interceptor. Flow was monitored from May 1,1996 through July 7,1996. A total of 4.95 inches of rainfall was recorded during the monitoring period. A hydraulic model using HydroWorks was used to evaluate the collection system under multiple flow routing scenarios. One of the scenarios investigated was rerouting the Wooded Acres lift station flow away from the West Bank Outfall. The report concluded that both dry weather and wet weather flows had decreased since the 1992 West Bank Outfall study which could have resulted from rehabilitation performed by the City of Waco as a result of previous field investigations and implementation of city ordinances regarding private service laterals. **It was noted that the 1992 West Bank Outfall study collected data during one of the wettest years on record while the 1998 study collected data during one of the driest years on record.**

Jan 2001: Dunkin, Sefko & Associates, Inc. and The Wallace Group, Inc. *Comprehensive Plan 2000*

The 2000 Comprehensive Plan included a section on the wastewater collection system. This section provided a set of eight wastewater collection recommendations within various basins**. A majority of the recommendations within the Comprehensive Plan supported the efforts previously conducted by GSWW during the previous eight years.** The following statement was included as part of the wastewater collection recommendations:

"It is noted that the West Bank Interceptor is overloaded and that the overloading contributes to problems in the Lindsey Hollow, Barron's Branch and Waco Creek major basins and that relieving the West Bank Interceptor would be the first step in the overflow problems in the older parts of the Waco sewer system."

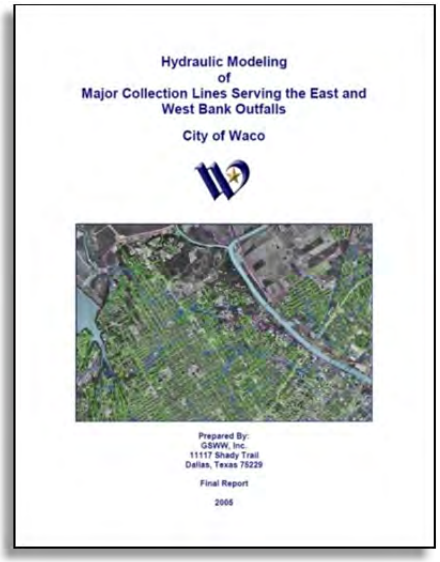
May 2003: InfraMetrix, LLC. *Diagnosis of Sanitary Sewer System*

The project utilized an Aqua Zoom camera to inspect portions of the City of Waco sewer system. The project consisted of the inspection of 3 manholes and 18 segments of collection system piping (along Archer Street, Myrtle Street and University Parks Drive) within the Barron's Branch and MLK wastewater basins. The final report recommended cleaning and CCTV inspection for certain locations.

The flow data collected was utilized within the subsequent City of Waco 2005 East and West Bank Hydraulic Modeling Report

Oct 2003: GSWW, Inc. ***Flow Monitoring Study (WMARSS) for City of Waco***

This technical memorandum recapped **flow monitoring activities that were performed for both WMARSS and the City of Waco from March 14 through June 28, 2003.** Twenty-five temporary flow meters (8 on the BRA interceptor system, 2 on City of Hewitt discharge points, 10 within the West Bank service area, and 5 within the East Bank service area) and 7 temporary rainfall gauges were installed within the collection system. A total of 6.50 inches of rainfall was recorded during the monitoring period. **It is noted that during the period that the flow metering equipment was installed, the Greater Waco area was experiencing significant drought conditions and minimal rainfall events occurred.** The WMARSS effort was memorialized in a master plan report prepared by Alan Plummer Associates, Inc. (APAI). Technical memoranda were written to both APAI and the City of Waco describing the flow monitoring results. The flow data collected was utilized within the subsequent City of Waco 2005 Hydraulic Modeling report prepared by GSWW.



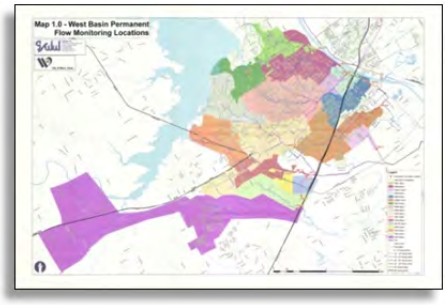
2005: GSWW, Inc. ***Hydraulic Modeling of Major Collection Lines Serving the East and West Bank Outfalls***

This report outlined the hydraulic modeling work completed using HydroWorks™. The existing West Bank hydraulic model was updated and expanded from prior modeling efforts. The updated model contained 975 nodes and 4 lift stations representing approximately 243,376 linear feet of sewer main. The update included the addition of 10-inch pipes into the model and recalibration using measured dry and wet weather flow data collected during 2003. A new model was created for the sewer basins that are upstream of the WMARSS East Bank Interceptor. This model contained 305 nodes and one lift station representing approximately 103,483 linear feet of sewer main. The APAI WMARSS model was combined such that the three models were used to evaluate and develop recommendations for system improvements. The model was calibrated using the 2003 flow meter data. The antecedent conditions represented in the model were skewed with regard to the existing groundwater table and infiltration rates since the flow monitoring occurred during drought conditions. The drought conditions provided little measured data to use in the calibration of the model for wet weather events and may have resulted in inaccurate peak flow representation in the model (lower than actual). The modeling scenarios utilized two different design storms in order to analyze wet weather conditions. The model analysis resulted in an average of 49 overflowing nodes in the amount 1.58 MGD under 2008 wet weather conditions. The report stated:

The 2005 East and West Bank Hydraulic Modeling Report stated: "Improvements required to prevent sanitary sewer overflows during periods of wet weather are numerous."

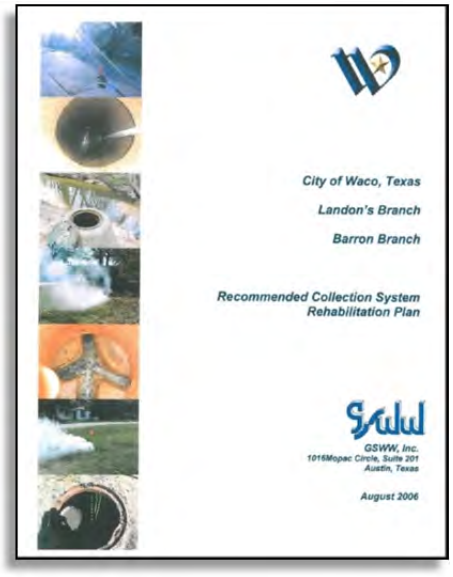
"Improvements required to prevent sanitary sewer overflows during periods of wet weather are numerous."

The report recommended system capacity improvements totaling an estimated $21,102,264 to address 2008 conditions and additional system improvements totaling an estimated $6,386,552 to address 2020 conditions.
Other recommendations included: additional hydraulic modeling, GPS mapping and surveying, continuation of the City's Sanitary Sewer Evaluation Program, and consideration for establishment of a permanent flow-monitoring network. Rerouting of the Landon Branch Lift Station away from the West Bank Interceptor and to the WMARSS Cottonwood Interceptor was also evaluated as part of this effort.



Jun 2005: GSWW, Inc. ***West Basin Permanent Flow Monitoring Plan – Technical Memorandum***
This technical memorandum presented proposed flow monitoring locations, equipment requirements, and estimated costs to install permanent flow meters and instrumentation within the City of Waco and WMARSS collection systems. **Sixteen locations were identified and investigated for consideration.** Meter stations were designed and installed at six of the sixteen locations. The memorandum discussed the various types of flow meters that could be used and the different options for data collection technology.

The motivation for undertaking the Landon's Branch and Barron's Branch Collection System Rehabilitation Plan was SSOI compliance reasons and repeated SSO's.



To date, a majority of the deficiencies that were identified within the 2006 report have been completed. The City is currently working on addressing the remaining locations identified within the final recommended deficiency list. These locations are included within the City's TCEQ Sanitary Sewer Overflow Initiative Agreement.

Aug 2006: GSWW, Inc. ***Landon's Branch and Barron's Branch Recommended Collection System Rehabilitation Plan***

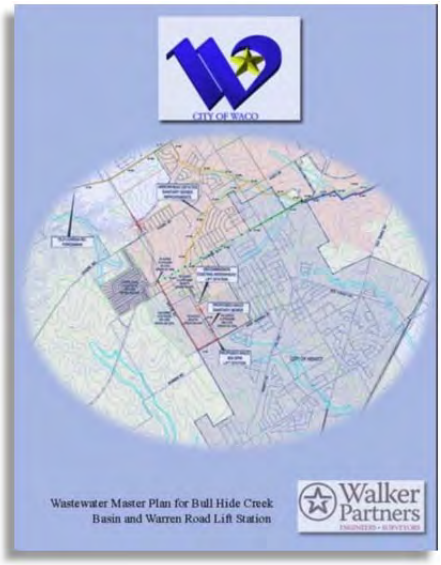
This report summarized all activities completed for the Landon's Branch and Barron Branch Basins. Major lift stations in the basins were evaluated, 300,000 linear feet of sewer main was visually examined, 1,239 manholes were inspected, and 19,439 linear feet of pipes were cleaned and inspected using CCTV equipment. GPS coordinates were collected for 1,052 locations throughout the study area and updates to the City's GIS were accomplished based on results gathered from the various investigations.

Flow monitoring was performed in the Landon's Branch and Barron's Branch Basins from March 22, 2005 through July 25, 2005. It was noted that very few wet weather events were recorded during the monitoring period. Flow measurement in the Landon's Branch Basin resulted in an average wet to dry peaking factor of 2.88. Flow measurement in the Barron's Branch Basin resulted in an average wet to dry peaking factor of 1.39. The report identified 1,201 sources of I/I contributing approximately 1,848 gpm (2.66 mgd) under moderate rainfall conditions.

The report also identified 1,002 system components that are considered structural and maintenance issues. The report recommended attempting to eliminate 1,848 gpm of potential I/I by various forms of rehabilitation at an estimated 2006 cost of $2,164,981. Detailed maps were created that identify all discovered defects, recommended repairs, etc. The report also recommended addressing the 1,002 structural and maintenance issues. **The study was undertaken due to the fact that the City continued to have hydraulic capacity and structural deterioration problems within these two basins.** Identifying solutions to address these issues was greatly needed. The 1994 Landon's Branch and Barron's Branch studies identified numerous deficiencies that the City diligently addressed with various system rehabilitation efforts. In spite of this, the 2006 study identified additional areas that required addressing. The identified deficiencies were more expensive and more difficult to repair than those included within the earlier studies. The 2006 Landon and Barron's Branch study identified four different methods of improvements: private service, open-cut, trenchless, and miscellaneous rehab (approximately 350 identified locations did not fit into the prior categories but still required attention). As part of the private service recommendation, the City performed a private service line rehabilitation and replacement project at an approximate cost of $100,000.

Aug 2008: Lockwood, Andrews and Newnam, Inc. ***Landon's and Barron's Branch Wastewater Line Replacement Preliminary Engineering Report***

This report outlined the preliminary design of system rehabilitation projects recommended by GSWW, Inc. within their August 2006 Landon's and Barron's Branch Report. GSWW, Inc. identified three types of required rehabilitation: open cut sewer main replacement, cured-in-place pipe, and pipe bursting. Lockwood, Andrews and Newnam provided preliminary design and developed probable construction costs for the open cut wastewater main replacement projects that were previously identified. The report provided a breakdown of the 17 identified open cut replacement segments and recommended that the City move forward (one of the segments was recommended to be evaluated for completion using trenchless methods). **The City of Waco has conveyed that as of November of 2013 that 10 of the 17 open cut segments have been constructed. The easement acquisition process has begun on the remaining 7 segments.**



Dec 2009: Walker Partners. ***Wastewater Master Plan for Bull Hide Creek Basin and Warren Road Lift Station***

This report outlined the feasibility study that was completed to analyze various alternatives for providing wastewater service to 304 acres of land that was recently annexed by the City of Waco (area bounded by Warren Road to the south, Ritchie Road to the west, and Arrowhead estates to the north). The 304 acres of land is located within the Castleman Creek drainage basin while a remaining area within Waco's ETJ is located within the Bull Hide Creek drainage basin. The study developed and analyzed three different options and recommended an option that transports flows generated in the Castleman Creek Basin through the Bull Hide Basin by a combination of a lift station and gravity sewer line and ultimately to the Bull Hide Creek WWTP. This option included the transfer of 0.23 MGD of wastewater flow towards the Bull Hide Creek WWTP as well as the potential to serve 4,800 acres within the Bull Hide Creek drainage basin. The estimated cost of the recommended option was $3,180,890.

The Tinkers and Wooded Acres Basin studies were performed as part of the City's TCEQ Sanitary Sewer Overflow Initiative Agreement.

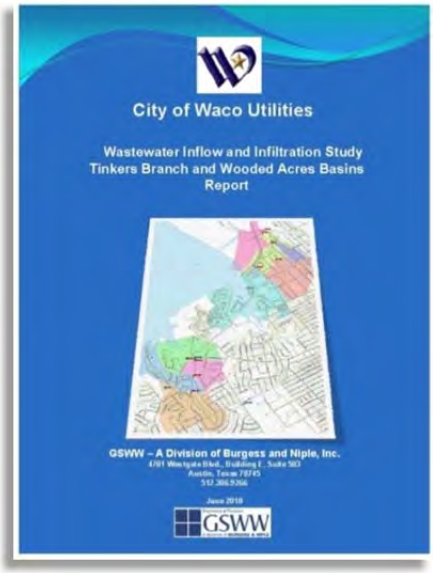
Mar 2010: GSWW, Inc. ***Tinkers and Wooded Acres Basins Sanitary Sewer System Evaluation Study – Flow Monitoring Site Selection Technical Memorandum***

This technical memorandum summarized the results of field investigations of potential temporary flow monitoring and rainfall monitoring sites. **The study was undertaken due to the fact that the City included these basins within their TCEQ Sanitary Sewer Overflow Initiative (SSOI) Agreement. These basins have historically experienced overflow related problems.** Ten temporary flow meters and 5 rain gage stations were installed at selected locations. Six of the temporary flow meters were installed in the Tinkers Branch Basin and 4 of the temporary flow meters were installed in the Wooded Acres Basin. The memorandum also provided maps showing the contributing basins for each temporary flow meter.

The Tinkers Branch sub-basin is located within the Bosque River Basin. The Wooded Acres sub-basin is located within the Twin Bridges Basin.

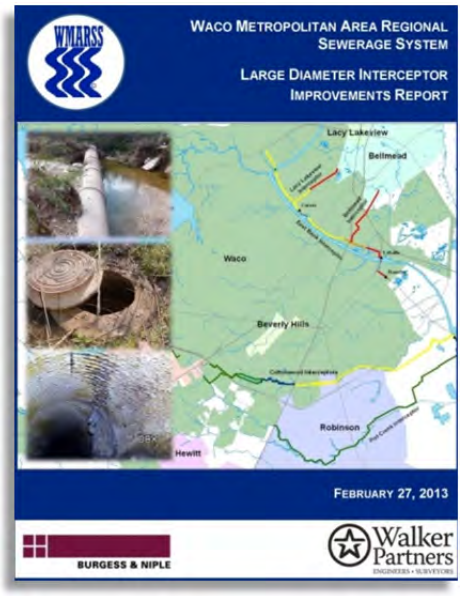
Jun 2010: GSWW, Inc. ***Tinkers and Wooded Acres Basin Wastewater Inflow and Infiltration Study Report***

This report outlined the results of flow monitoring that was performed in the Tinkers and Wooded Acres Basin for 81 days from March 2, 2010 to May 15, 2010. **The study included both above and below ground investigations and smoke testing which resulted in identifying multiple manhole and pipe infiltration sources, surcharged manholes and sanitary sewer overflow locations.** Flow measurement in the Tinkers Branch Basin resulted in an average wet to dry peaking factor of 4.95. Flow measurement in the Wooded Acres Basin resulted in an average wet to dry peaking factor of 1.67. All data was thoroughly analyzed and a ranking of meter sub-basins was established according to the amount of I/I being contributed to the sewer system.



Jul 2010: GSWW, Inc. ***Tinker's Branch and Wooded Acres Recommended Collection System Rehabilitation Plan***

This report summarized all activities completed for the Tinker's Branch and Wooded Acres Basin. **Smoke testing was completed for 100% of the study area, lift stations in the basins were evaluated, 118,170 linear feet of sewer main was visually examined, 421 manholes were inspected, and 16,663 linear feet of pipe was cleaned and inspected using CCTV equipment.** GPS coordinates were collected for 333 locations throughout the study area and updates to the City's GIS were made based on results gathered from the various investigations. The report identified 538 sources of I/I contributing approximately 870.5 gpm (1.25 mgd) under moderate rainfall conditions. The report also identified 150 system components that are considered structural / maintenance issues. The report recommended attempting to eliminate 870.5 gpm of potential I/I by various forms of rehabilitation as well as addressing 150 structural / maintenance issues at an estimated 2010 total cost of $1,698,675. GSWW also recommended that hydraulic models be developed for the Tinker's Branch and Wooded Acres sub-basins.



Feb 2013: Walker Partners / Burgess & Niple. ***Large Diameter Interceptor Improvements Report for WMARSS***
This report outlined an investigation and study of the WMARSS gravity wastewater interceptor collection system as well as the development of a Capital Improvements Program that included 6 major new construction, rehabilitation or replacement projects. The WMARSS collection system was evaluated for both structural condition and hydraulic capacity. Above ground inspections were conducted along 100% of the interceptors and manhole inspections were completed for 180 of the approximately 220 WMARSS manholes. **The report concluded that the age of the system is approaching 50 years in age and the overall condition ranged from "fair" to "very poor."** Proposed improvements were broken into two lists: "Immediate Needs Projects" and "3-10 Year CIP Projects." The "Immediate Needs Projects" included projects having an estimated construction cost of $2,309,170.00 while the "3-10 Year CIP Projects" included projects having an estimated total project cost of $69,318,000.00.

2.1.3. Drawings / Maps

The WMARSS CIP identified $72M of wastewater improvement projects that are required during the next 10 years.

Over the last 20 year period, the system maps have been updated via several methods, including updates from maintenance activities conducted by the City, evaluation work conducted by the consulting community and revisions made due to development and redevelopment activities.

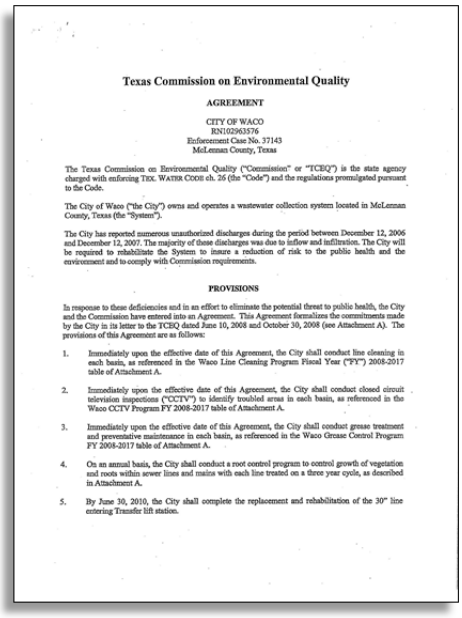
The current GIS-based City of Waco Sanitary Sewer Maps were originally developed from hand drawn (mylar) grid maps starting in the early 1990's. The manholes and other system nodes were hand-numbered based on their location on a particular grid. These mylar maps were translated, using automated methods, into CADD maps (AutoCAD) during the mid-1990's. The CADD maps were then translated into ESRI GIS shapefiles for use with the City's newly adopted GIS in the late 1990's. During this process, the system maps have been updated via several methods, including updates from maintenance activities conducted by the City, evaluation work conducted by the consulting community and revisions made due to development and redevelopment activities.

Although the collection system maps have been through several transitions from the original mylar maps to the City's GIS, **it is believed that the current mapping system reasonably depicts the collection system at this time.**

Record drawings were reviewed from the Waco GIS Map Service website. Drawings not available through the website were requested and obtained from City GIS staff. Record drawings were reviewed to obtain information about the physical geometry of the collection system and utilized as the basis for the data file within the model.

In addition, available lift station drawings were collected and reviewed in order to obtain details on the connection of the gravity lines to the wet wells, wet well volumes, pumps installed at each lift station, and pump operating settings (where available). This data was utilized to represent pumps and wet well storage within the hydraulic model.

2.1.4. Other System Data



Texas Commission on Environmental Quality

AGREEMENT

CITY OF WACO
RN102963576
Enforcement Case No. 37143
McLennan County, Texas

The Texas Commission on Environmental Quality ("Commission" or "TCEQ") is the state agency charged with enforcing TEX. WATER CODE ch. 26 (the "Code") and the regulations promulgated pursuant to the Code.

The City of Waco ("the City") owns and operates a wastewater collection system located in McLennan County, Texas (the "System").

The City has reported numerous unauthorized discharges during the period between December 12, 2006 and December 12, 2007. The majority of these discharges was due to inflow and infiltration. The City will be required to rehabilitate the System to insure a reduction of risk to the public health and the environment and to comply with Commission requirements.

PROVISIONS

In response to these deficiencies and in an effort to eliminate the potential threat to public health, the City and the Commission have entered into an Agreement. This Agreement formalizes the commitments made by the City in its letter to the TCEQ dated June 10, 2008 and October 30, 2008 (see Attachment A). The provisions of this Agreement are as follows:

1. Immediately upon the effective date of this Agreement, the City shall conduct line cleaning in each basin, as referenced in the Waco Line Cleaning Program Fiscal Year ("FY") 2008-2017 table of Attachment A.
2. Immediately upon the effective date of this Agreement, the City shall conduct closed circuit television inspections ("CCTV") to identify troubled areas in each basin, as referenced in the Waco CCTV Program FY 2008-2017 table of Attachment A.
3. Immediately upon the effective date of this Agreement, the City shall conduct grease treatment and preventative maintenance in each basin, as referenced in the Waco Grease Control Program FY 2008-2017 table of Attachment A.
4. On an annual basis, the City shall conduct a root control program to control growth of vegetation and roots within sewer lines and mains with each line treated on a three year cycle, as described in Attachment A.
5. By June 30, 2010, the City shall complete the replacement and rehabilitation of the 30" line entering Transfer lift station.

In 2009, the City voluntarily entered into the Sanitary Sewer Overflow Initiative program operated by the TCEQ. This program is scheduled to be in effect until December 2017.

The City has done an excellent job over the last four years to decrease the number of SSOs, update their Standard Operating Procedures and educate staff regarding the SSOi program.

The City of Waco was the subject of an Administrative Order from the U.S. Environmental Protection Agency (EPA) in 1992, which required the City to perform certain tasks designed to eliminate recurrent unauthorized discharges from the wastewater collection system during wet weather events. When the program began, the City had mapped more than 75 recurrent overflow locations. Significant progress was made in the program and in 1999 the City was released from the Administrative Order. At that time, eight recurrent overflow locations remained active during severe wet weather events.

The City is not currently the subject of a EPA Administrative Order regarding the wastewater collection system. The City entered into a voluntary program operated by the Texas Commission on Environmental Quality (TCEQ) called the Sanitary Sewer Overflow Initiative (SSOi). The SSOi program began in 2009 and is scheduled to be in effect until December 2017.

During the period beginning in 2004, the City began to experience an increase in unauthorized discharges and was the subject of several administrative fines and penalties levied by the State of Texas. This period of degraded system performance led the City of Waco to enter into its current SSOi agreement with the TCEQ. **The original 2009 agreement outlined a list of 13 provisions that must be completed by the City in an effort to improve the functionality of the wastewater system.** The provisions included items such as: line cleaning, closed circuit television inspections, grease treatment / preventative maintenance, root control, various line rehabilitation / replacement projects, new interceptor construction, specific basin inflow & infiltration studies, and potential flow reroutes. As part of the agreement, the City has agreed to provide yearly updates regarding progress made under the program. The City's 2013 yearly update enumerated that greater than 50% of the original 2009 provisions had been completed to date. In addition to this, an additional five provisions have been significantly accomplished over the prior four years and the City continues to make continual progress. Only one of the original 13 provisions has not been initiated as of the 2013 update and the City requested as part of the 2013 update that this provision be revised to allow the WWMP Team to re-evaluate the original scope of the project to ascertain if a more deliberate design solution could be determined.

A summary of major maintenance activities the City has performed as part of the SSOi over the last 3 years includes:

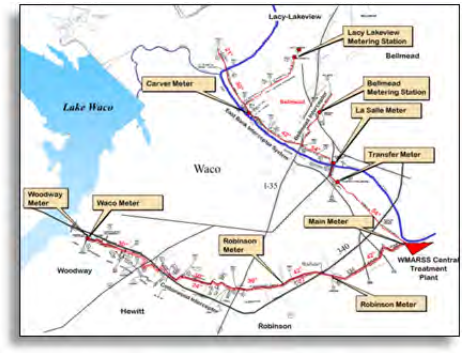
- 223,000 LF of sewer main cleaned
- 219,900 LF of sewer main inspected (CCTV)
- 498,200 LF of grease treatment
- $211,700.00 for root control
- 6 each of sewer main replacement / rehabilitation projects completed

Existing pipe condition of the WMARSS Bellmead Interceptor

In the end, the SSOi Agreement does not prevent the City from incurring penalties for unauthorized collection system discharges during the period of time covered by the agreement. However, the City has done an excellent job over the last four years to decrease the number of SSOs, update their Standard Operating Procedures and educate staff regarding the SSOi program. **Despite the City of Waco's efforts, sanitary sewer overflows continue to occur. The primary causes of these discharges are related to system maintenance issues such as grease buildup in the system, failure of aging infrastructure, and capacity issues.** The City continues to work diligently to address these known issues.

WMARSS 2051 Estimated System Capacity as part of the February 2013 WMARSS Large Diameter Interceptor Improvements Report

Capacity during wet weather events has been an issue for the City over the years. The City of Waco discharges its untreated wastewater to the Waco Metropolitan Area Sewerage System (WMARSS) for final transportation and treatment. There are a number of interconnections and flow pass-throughs to the City's system from other WMARSS member cities. **During wet weather events, especially major events, the WMARSS interceptor system, lift stations and treatment facilities can become hydraulically overloaded.** This condition is compounded by hydraulic capacity issues known to be present within the surrounding WMARSS cities. Table 2-2 presents historical wastewater flow data taken from the February 2013 WMASS Large Diameter Interceptor Improvements Report from various monitoring points in the WMARSS and City of Waco collection systems:



WMARSS Flow Metering Station Location Map (Prior to the WMARSS Flat Creek and Bull Hide Creek Sewer System Improvements)

Table 2-2: Historical WMARSS Metered Flow Data

Location	Avg Daily WW Flow	Peak Daily WW Flow	Peaking Factor
Lacy Lakeview MS	0.49	2.7	5.5
Carver LS	3.21	17.8	5.5
Bellmead MS	0.99	11.0	11.1
LaSalle LS	6.63	30.4	4.6
Transfer LS	10.60	84.0	7.9
Woodway @ Woodway LS	1.16	8.4	7.2
Waco @ Woodway LS	1.30	8.0	6.2
Robinson US 77 MS	0.05	0.3	6.0
Robinson 12th Str MS	0.14	2.0	13.3
Main LS	11.71	66.3	5.7

Table 2-3 presents the corresponding March 19-20, 2012 rainfall event data taken from the February 2013 WMARSS Large Diameter Interceptor Improvements Report:

WMARSS 2012 Existing Conditions Peak Wet Weather Flow Node Map

Table 2-3: Historical WMARSS March 19-20, 2012 Rainfall Event Data

Location	2006, 2007, 2011, 2012 (WMARSS Provided) 7 Maximum Peak Daily Flows (MGD)
Lacy Lakeview MS	2.6, 2.6, 2.2, 2.1, 2.1, 2.0, 2.0
Carver LS	17.8, 10.8, 8.4, 8.3, 8.1, 8.1, 8.0
Bellmead MS	11.0, 10.7, 10.1, 7.8, 7.7, 7.2, 7.2
LaSalle LS	30.4, 20.4, 19.2, 18.7, 18.5, 18.2, 18.0
Transfer LS	84.1, 83.6, 82.4, 80.8, 78.7, 74.8
Woodway @ Woodway LS	8.4, 4.4, 3.5, 3.5, 3.4, 3.2, 3.1
Waco @ Woodway LS	7.4, 6.2, 6.2, 4.7, 3.9, 3.4, 3.2
Robinson US 77 MS	0.33, 0.3, 0.3, 0.2, 0.2, 0.2, 0.2
Robinson 12th Str MS	1.99, 1.72, 0.64, 0.63, 0.43, 0.4,
Main LS	66.3, 56.7, 46.4, 42.5, 40.7, 36.7

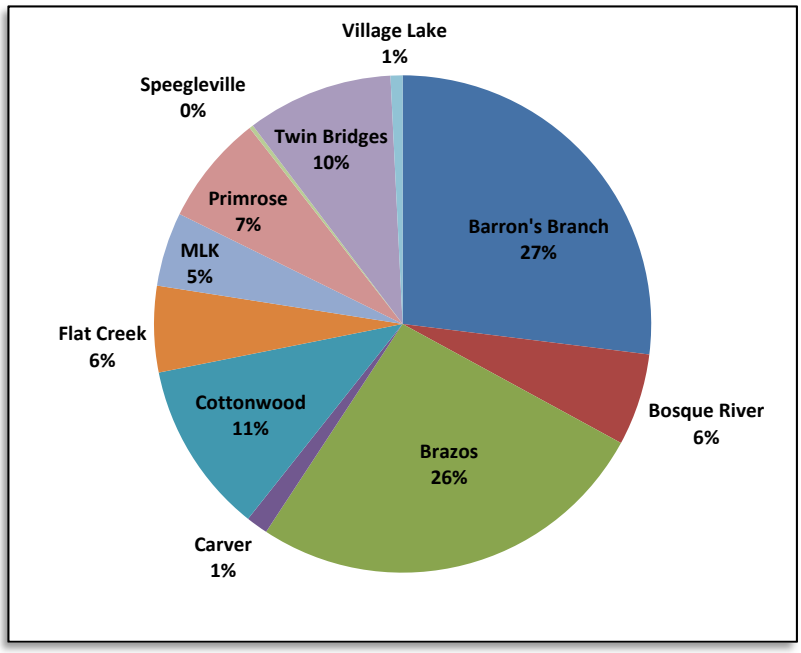
The data presented in Table 2-3 is “totalized” data; that is data that is totalized over a 24 hour period. Totalizing data is a common practice in the wastewater industry. It reduces the volume of data stored in a significant manner. However, totalizing removes data that is used to create a 15 minute or hourly diurnal curve of the wastewater flow data over a 24 hour period.

The City of Waco wastewater collection system is interconnected with the collection systems operated by Woodway, Hewitt, McGregor, Bellmead and Lacy Lakeview at various locations. These locations surround Waco's system to the north, south and west. **Several of the locations are regulated by joint sewer use agreements that have been executed over the course of the last 5 decades.** Figure 2-1 provides a map that shows the various known locations. The map was developed based upon review of historical information provided to the Team by the City as well as meeting with long-time City staff to discuss their institutional knowledge regarding each location and associated sewer use agreement.

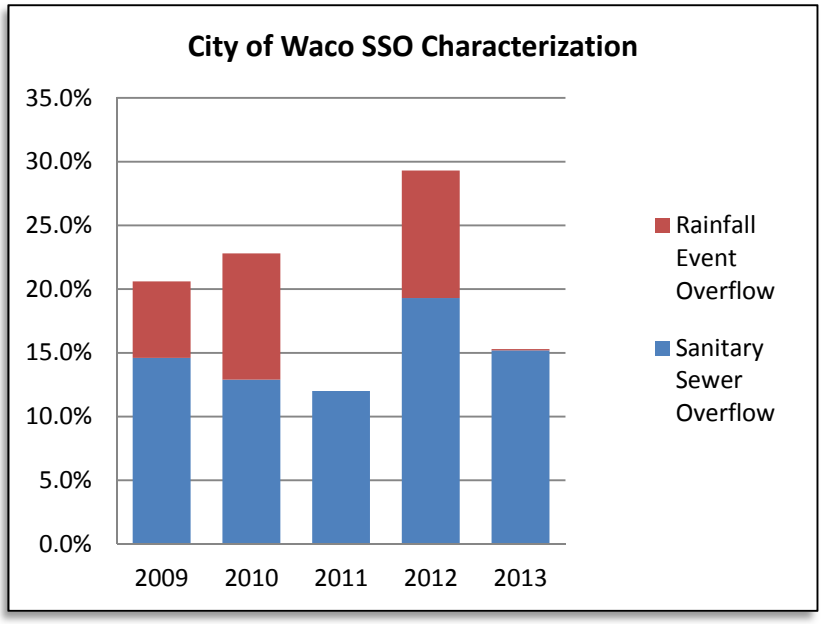
Water Utilities provided the Team a geodatabase of work orders through the City's HTE database. The City provided data going back to 1998, which included over 46,700 coded work orders. Water Utilities staff is able to label their work orders under one of approximately 65 different codes. **After review, it was determined and agreed upon by the City and Team to only utilize the work order data from the last 5 years (2009-2013) as being both more reliable and representative of the existing collection system** (approximately 16,400 coded work orders). From this database, the Team filtered two codings with a total of 789 events: Sanitary Sewer Overflow (SSO) and Rainfall Event Sanitary Sewer Overflow (RFE) for further evaluation. The final listing of these locations is shown within Figure 2-2. It is realized that these data points may not be indicative of every location within the collection system that overflows occur, but it does show the locations that the Water Utilities staff is aware of. There are likely additional locations that have not been captured as part of the City's work order efforts, but it is considered to be a very good indicator of areas within the system that have deficient hydraulic capacity. The City currently does not have a way to identify each and every area. **It is critical to capture these locations to assist in the future proposed improvements and prioritization effort to assist in determining locations that must be addressed as part of the future identified improvements.**

The following graph shows the percentage of work orders that are located within each major sanitary sewer basin within the City's wastewater collection system. It can be seen that approximately 55% of the City's work order related activities over the last 5-year period are located within the Barron's Branch and Brazos wastewater basins. The work order information indicates that concentrations of the work orders are located within the older and more established wastewater basins within the City.

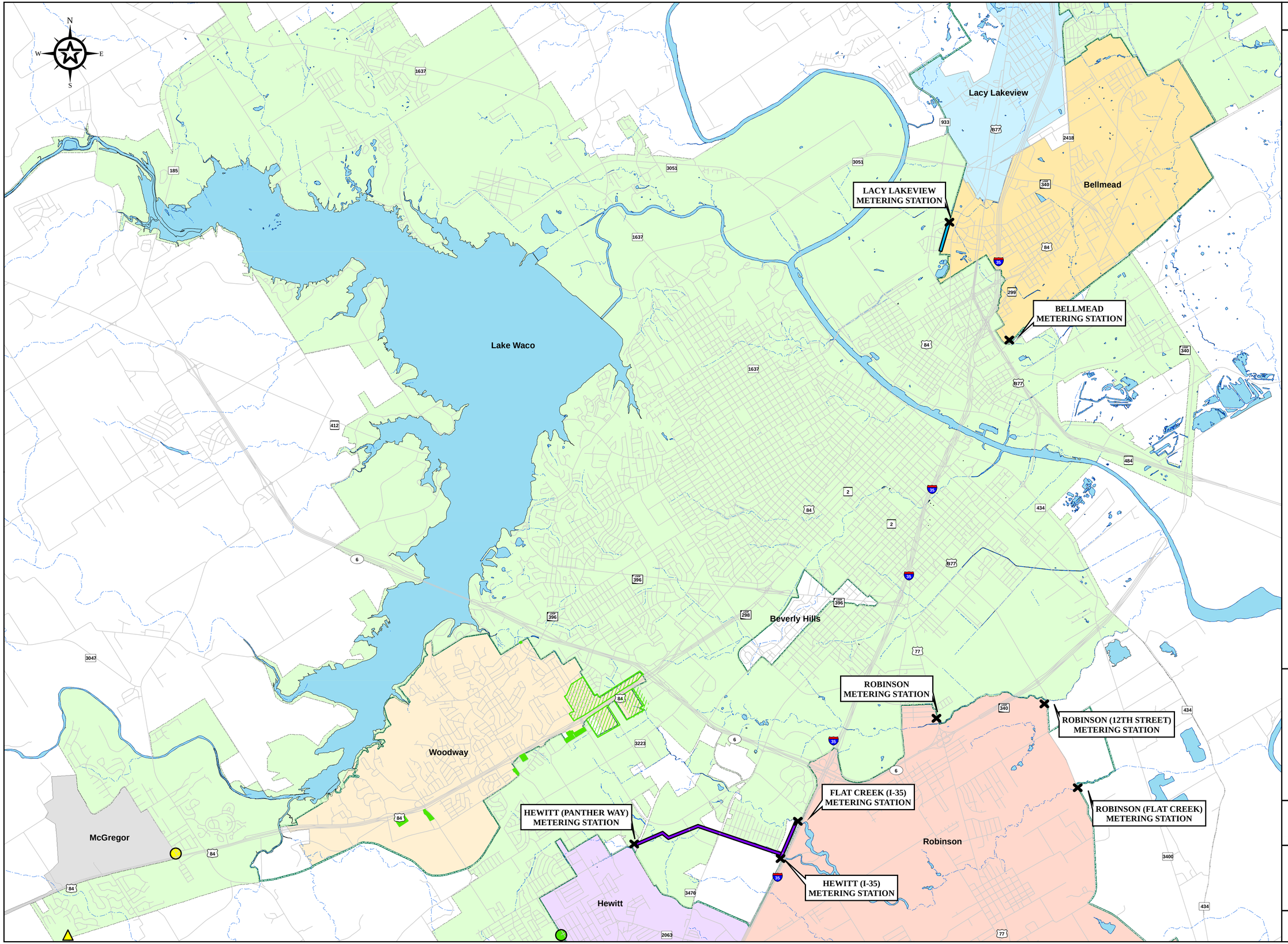
Approximately 55% of the City's work order related activities over the last 5-year period are located within the Barron's Branch and Brazos wastewater basins.



The following graph shows the percentage of work orders that occurred over the last five years with the two codings that produced a total of 768 events.



Several conclusions were drawn per the review of the 2009-2013 Rainfall Event Sanitary Sewer Overflow work order (HTE) data within Figure 2-2. In general, the sanitary sewer overflow and rainfall event sanitary sewer overflow information indicates that concentrations of the work orders are located within older and more established portions of the City. The Barron's Branch, Cottonwood, Brazos and Twin Bridges basins should be examined the closest with attention given to the Landon Branch and Wooded Acres lift stations.



LEGEND

- City of Bellmead
- City of Hewitt
- City of Lacy Lakeview
- City of McGregor
- City of Robinson
- City of Woodway
- Sewer Service Provide by City of Waco
- Sewer Service Provide by City of Waco (Lot)
- Potential McGregor to Waco Connection Point
- McGregor to Waco Connection Point
- City of Waco Sewer Line Conveying Hewitt Flows
- Waco to Hewitt Connection Point
- City of Waco Sewer Line Conveying Lacy Lakeview Flows
- WMARSS Metering Station
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

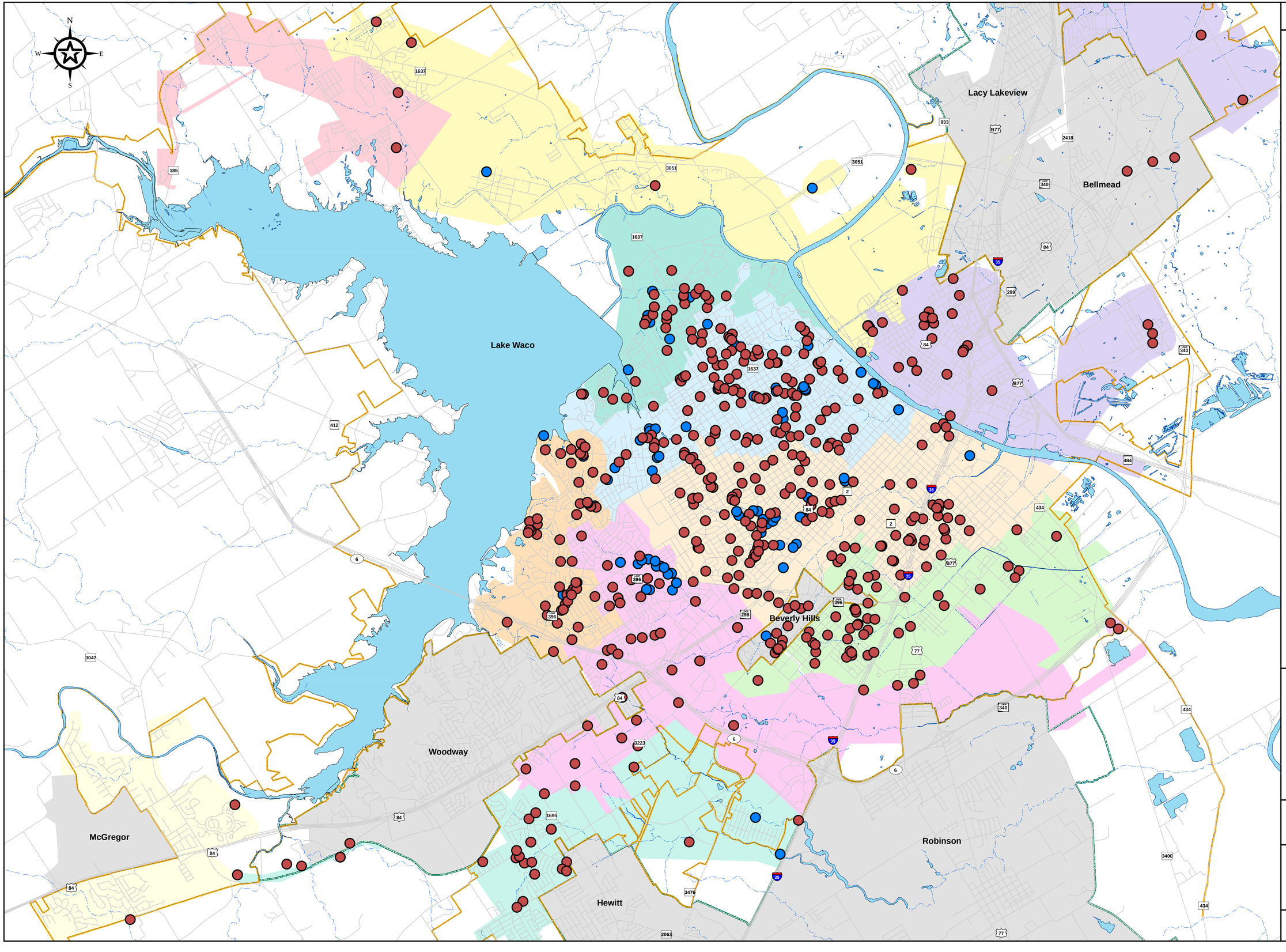
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 2-1: System Interconnection Map

G:\GIS\Projects\1-02231\Mapsl\System Interconnection Map.mxd



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- Rainfall Event Sanitary Sewer Overflow (RFE) 2009-13: Total of 200 Events
- Sanitary Sewer Overflow (SSO) 2009-13: Total of 589 Events
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 2-2: SSO / RFE Map

G:\GIS\Projects\1-02231\Maps\SSO-RFE Map.mxd

2.2 Description of the Existing Wastewater System

Natural topography is important in wastewater systems since sanitary sewer lines are more economically constructed as gravity flow conduits. Gravity lines can be installed up to a practical limit of depth (due primarily to costs involved in excavation and working conditions). When this practical limit is reached (generally at locations where the wastewater needs to be transported from one drainage basin to another), lift stations are required in order to lift the wastewater over a natural divide.

As in most municipalities, Waco's collection system has been built over the last 70 years with many of the older lines being comprised of vitrified clay tile pipe which is very susceptible to cracking, joint separation and tree root intrusion. These issues contribute heavily to the amount of inflow and infiltration seen within the system. These lines are generally in most need of rehabilitation and/or replacement as well as not having sufficient hydraulic capacity during wet weather events.

The City of Waco operates and maintains a wastewater collection system consisting of approximately 3,729,000 linear feet of gravity and force main pipe ranging in size from 2" to 66", as well as 57 active lift stations in the system ranging in size from approximately 50 gpm to 2,250 gpm. **The entire collection system services approximately 37,400 sewer connections** (per City of Waco Utilities).

The collected wastewater is transmitted to the Waco Metropolitan Area Sewerage System (WMARSS) for final conveyance and treatment.

2.2.1. Major Basins

The wastewater collection system currently consists of 11 major basins. A map of the City of Waco major sanitary sewer basins is shown in Figure 2-3.

THIS PAGE IS INTENTIONALLY LEFT BLANK

LEGEND

- Barron's Branch (BB)
  (Barron's Branch, Cameron Park 2, Deerwood, Hillcrest, Landon Branch, Lindsey Hollow, Lovers Leap, South Landon Branch, Windmill Hill)
- Bosque River (BR)
  (Bosque River, Chimney Hill, Greenleaf, Park Lake, Village Green)
- Brazos (BZ)
  (Brazos, Waco Creek North, Waco Creek South)
- Carver (CR)
  (Airport, Avon, Bosqueville, Carver, Falcon Pointe, Key's Creek, The Landing, Mammoth Site, Parkview, Riverbend Ball Park, Steinbeck Bend)
- Cottonwood (CW)
  (Cottonwood, FM 434, South 12th, Syrian Club, Upper Cottonwood, Upper Waco Creek)
- Flat Creek (FC)
  (Arrowhead, Flat Creek, North Flat Creek, Panther Way)
- Martin Luther King (MLK)
  (Chicken Shack, East MLK, Lincoln Park, McLennan County Jail, TSTC, West MLK)
- Primrose (PR)
  (Primrose, South Primrose, TX State Little League, VA, West Primrose)
- Speegleville (SP)
  (Hwy 84 Lawyer, Buckingham, Harris Creek, Ledgestone, River Park, Riverside, Speegleville, Stone Creek, Twin Rivers)
- Twin Bridges (TB)
  (Inverness, Lake Shore, Mt. Selma, Ridgewood, Twin Bridges, Wooded Acres)
- Village Lake (VL)
  (China Spring, Flat Rock, FM 185, Village Lake, Yankie)
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

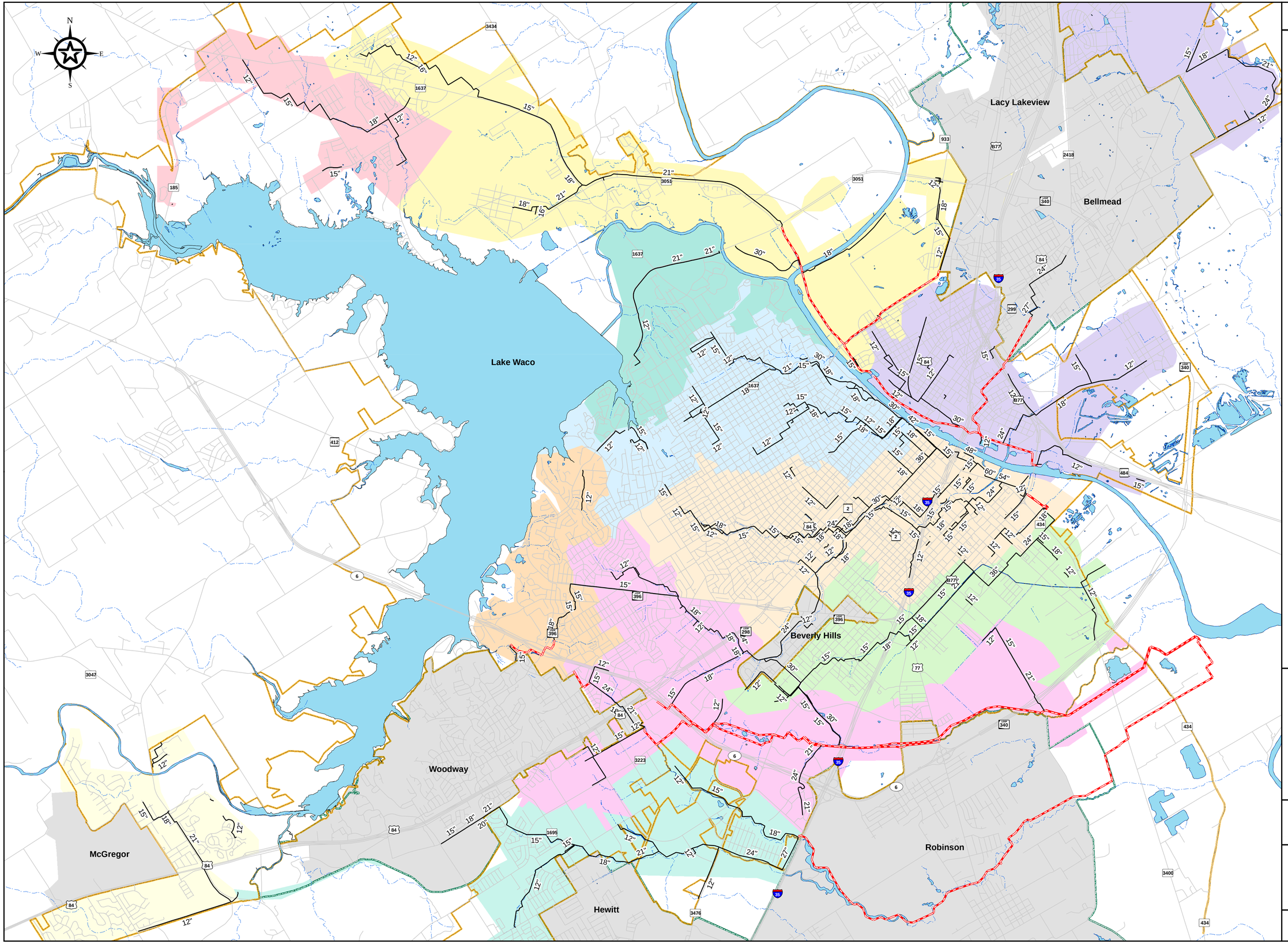
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 2-3: Major Sanitary Sewer Basins

G:\GIS\Projects\1-02231\Maps\BasinMap.mxd



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- City of Waco Gravity (12-Inch and Greater)
- WMARSS Gravity
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1625 3250 6500

GRAPHIC SCALE (FEET)

Figure 2-4: Gravity Main Map

G:\GIS\Projects\1-02231\Maps\Gravity Map.mxd

2.2.2. Collection Lines

The City of Waco Wastewater Collection System has a total line length of over 3.7 million linear feet.

Figure 2-4 shows the location of the wastewater collection system serving the City of Waco as well as the WMARSS gravity lines. Table 2-4**:** shows the types and lengths of pipe found in the City of Waco wastewater collection system.

Table 2-4: Pipe Summary

Type	Approximate Length (FT)	Percent of Length of System
Gravity Main	3,548,900	95.2%
Force Main	180,500	4.8%
Total Length	**3,729,400**	**100.0%**

Note: The approximate length shown in this table does not include WMARSS assets.

Table 2-5: shows the length of gravity pipe by diameter within the City of Waco wastewater collection system.

Table 2-5: Gravity Main Summary

Line Size (IN)	Approximate Length (FT)	Percent of Length of Gravity
4”	4,400	0.1%
6”	1,386,700	39.1%
8”	1,234,900	34.8%
10”	286,500	8.1%
12”	173,100	4.9%
15”	171,300	4.8%
16”	3,400	0.1%
18”	98,200	2.8%
20”	800	≤0.1%
21”	65,700	1.9%
24”	59,300	1.7%
27”	12,000	0.3%
30”	24,900	0.7%
33”	100	≤0.1%
36”	14,700	0.4%
42”	1,800	≤0.1%
48”	5,000	0.1%
54”	3,200	0.1%
60”	2,300	0.1%
66”	600	≤0.1%
Total	**3,548,900**	**100.0%**

Note: The approximate length shown in this table does not include WMARSS assets.

Figure 2-5 shows the location of the force mains within the wastewater collection system.

THIS PAGE IS INTENTIONALLY LEFT BLANK

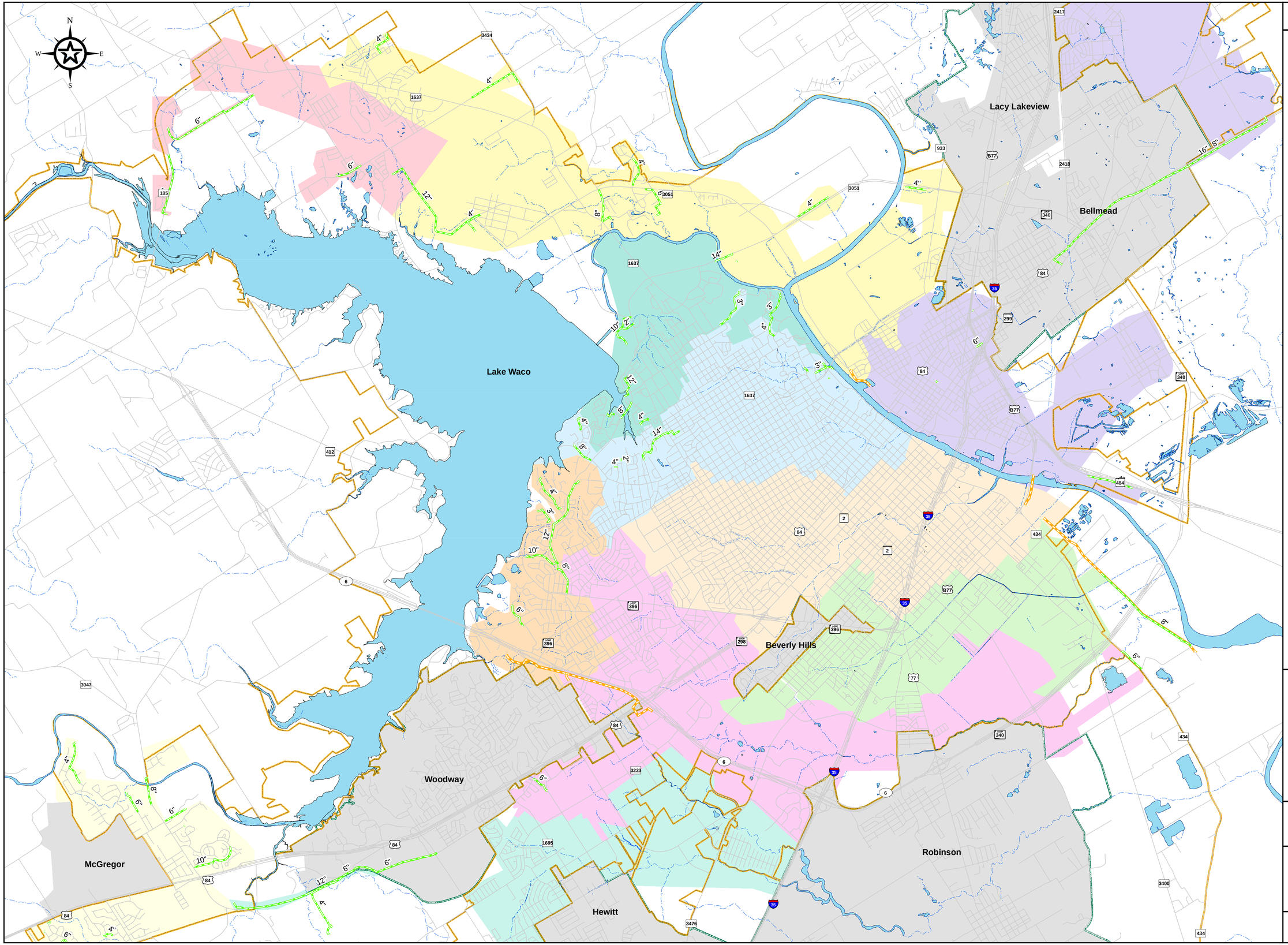


Figure 2-5: Force Main Map

G:\GIS\Projects\1-02231\Maps\Force Main Map.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

Table 2-6: Force Main Summary

Line Size (IN)	Total Length (FT)	Percent of Length of Force Main
2”	1,700	0.9%
3”	8,300	4.6%
4”	35,100	19.4%
6”	37,400	20.7%
8”	30,600	17.0%
10”	8,100	4.5%
12”	35,500	19.7%
14”	4,800	2.7%
16”	18,800	10.4%
36”	100	0.1%
42”	100	≤0.1%
Total	**180,500**	**100.0%**

2.2.3. Manholes

Per City of Waco Utilities, the City’s collection system has approximately 12,459 manholes and junction structures. System wide manhole visual inspections were not conducted as part of this engagement. However, a very small percentage of manholes (approximately 75 of the 12,459 within the system, or less than 1%) were observed as part of the flow monitoring and field survey verification items of work. These examinations indicated that the manholes observed were in various states of degradation. No system information was gathered as to manhole material type (i.e. brick, concrete, fiberglass, etc.).

It is generally assumed that the manholes that were originally installed before 1970 are currently in need of rehabilitation. Further, it is generally assumed that manholes constructed in the 1970’s and 1980’s may require rehabilitation in the not too distant future.

Per the Teams cursory review of the available City GIS data, the following information was generated as to original manhole construction dates and the current age of the manholes within the system. **Table 2-7** shows the age of manholes found within the wastewater collection system.

Table 2-7: Manhole Age Summary (COW GIS)

Original Construction Date Range	Age (YR)	Number of Manholes
Unknown		6266
Prior to 1960	>54	257
1960 - 1969	45-54	446
1970 - 1979	35-44	435
1980 – 1989	25-34	802
1990 - 1999	15-24	1419
2000 - 2014	0-14	2834
Total		**12,459**

Concrete and brick manholes typically suffer from the environmental effects of hydrogen sulfide attack of the uncoated concrete. It is generally assumed that manholes originally installed before 1970 (>44 years) are currently in need of rehabilitation. Further, it is generally assumed that manholes constructed in the 1970's and 1980's may require rehabilitation in the not too distant future. Collecting the predominant construction material and original construction date data for each manhole within the system is an important piece of information when determining future recommended rehabilitation or replacement methods as well as the remaining useful life of a structure. It is recommended that the City further develop their system data to include this information.

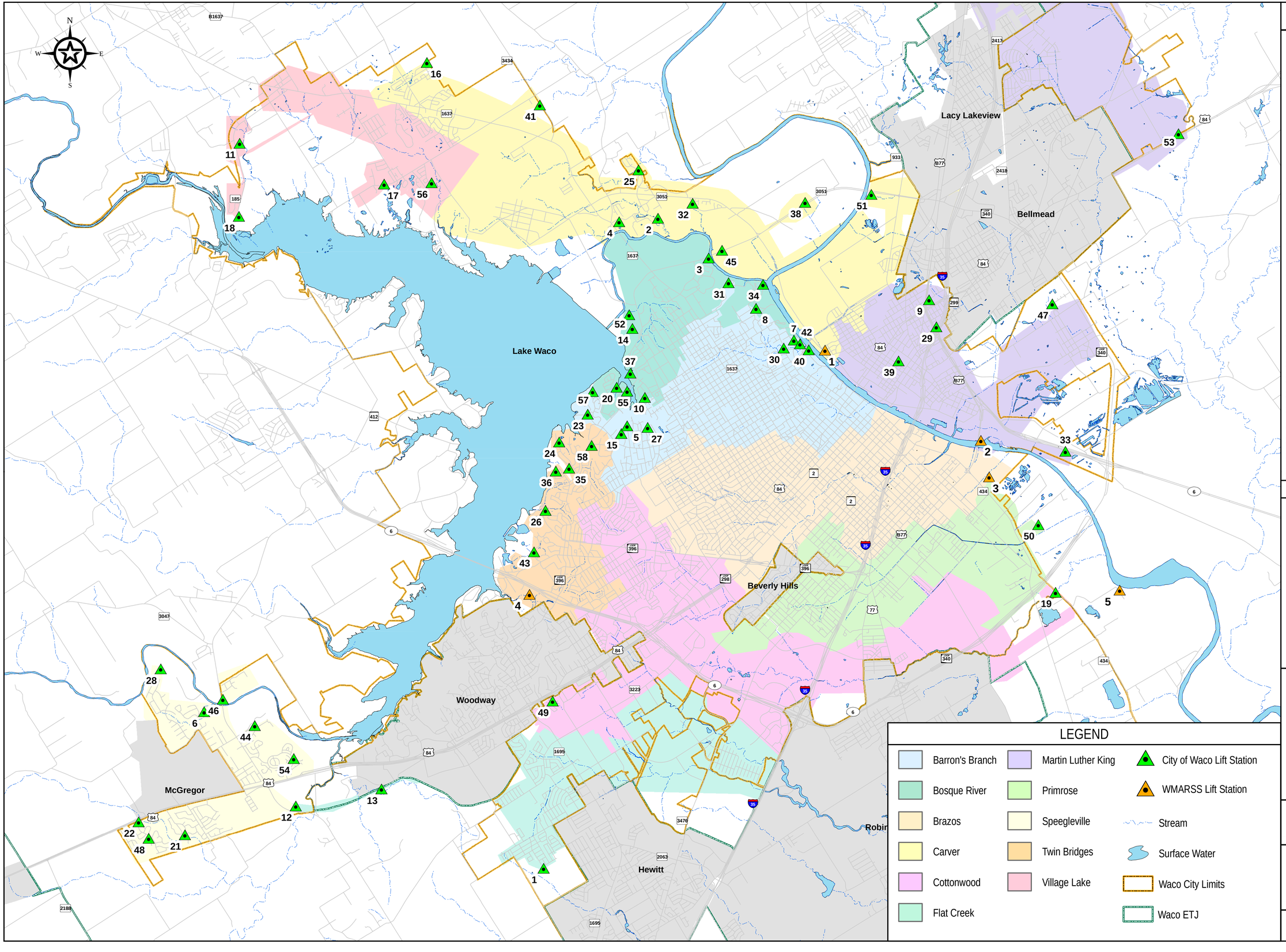
Many of the wastewater mains within the collection system that are not located within a City street or improved right-of-way are located in close proximity to natural drainage ways. A majority of the associated manholes are located in low lying areas or the floodplain of various creeks and streams located within the City limits. While this is a common practice for the design and construction of wastewater mains, the placement of manholes in drainage ways introduces the potential for excessive inflow and infiltration into the system. Typically, inflow is the result of direct storm water runoff; while infiltration occurs as storm water percolates through the soil surrounding the buried portion of the manholes. As an example, separate testing of a typical cast iron non-watertight manhole cover that is continuously placed under just one foot of water can allow between 15 and 20 gallons per minute of extraneous water to enter the collection system via the non-watertight seal between the manhole cover and frame. Should this non-watertight manhole have additional defects, the amount of extraneous water entering the system can be significantly greater. It is assumed that a large percentage of these manholes are not outfitted with watertight manhole frame and cover combinations. To further exacerbate the inflow problem, it's also assumed that a majority of these manholes were constructed "at grade," meaning that the manhole cover is flush with the surrounding ground.

A typical non-watertight manhole cover that is continuously placed under just one foot of water can allow between 15 and 20 gallons per minute of extraneous water to enter the collection system via the non-watertight seal between the manhole cover and frame.

2.2.4. Lift Stations

Figures 2-6 and 2-7 show the locations and a schematic of the lift stations within the wastewater collection system.

Table 2-8 provides a summary of the active lift stations serving the wastewater collection system.



CITY OF WACO LIFT STATIONS

1	Arrowhead	30	Lindsey Hollow
2	Avon	31	Lover's Leap
3	Bosque	32	Mammoth Site
4	Bosqueville	33	McLennan Co. Jail
5	Braemar	34	Mouth of the Bosque
6	Buckingham	35	Mt. Carmel
7	Cameron Park	36	Mt. Selma
8	Cameron Park 2	37	Park Lake
9	Chicken Shack	38	Parkview
10	Chimney Hill	39	Paul Quinn
11	China Spring	40	Pecan Bottoms
12	Church Road	41	
13	Cloice Creek	42	Redwood Shelter
14	DAF Plant	43	Ridgewood
15	Deerwood	44	River Park
16	Falcon Pointe	45	Riverbend Ball Fields
17	Flat Rock	46	Riverside
18	FM 185	47	South Fork
19	FM 343	48	Stone Creek
20	Greenleaf	49	Syrian Club
21	Harris Creek	50	Tx St Little League
22	Hwy 84 Lawyer	51	The Landing
23	Hillcrest	52	Tinker's Branch
24	Inverness	53	TSTC
25	Key's Creek	54	Twin Rivers
26	Lake Shore	55	Village Green
27	Landon Branch	56	Village Lake
28	Ledgestone	57	Windmill Hill
29	Lincoln Park	58	Wooded Acres

WMARSS LIFT STATIONS

1	Carver	4	Woodway
2	LaSalle	5	Main
3	Transfer		

LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- City of Waco Lift Station
- WMARSS Lift Station
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1750 3500 7000

GRAPHIC SCALE (FEET)

Figure 2-6: Lift Station Map

G:\GIS\Projects\1-02231\Maps\Lift Station Map.mxd

LIFT STATION FLOW SCHEMATIC

VL
CR
MLK
BR
BB
BZ
PR
TB
CW
SP
FC

China Spring
FM 185
Flat Rock
Village Lake
Falcon Pointe
Pioneer Pkwy
Bosqueville
Key's Creek
Avon
Parkview
Mammoth Site
Riverbend Ball Fields
The Landing
Lacy Lakeview
TSTC
Chicken Shack
Lincoln Park
Paul Quinn
Bellmead
South Fork
McLennan County Jail
Carver
East Bank
LaSalle
Transfer
Greenleaf
DAF Plant
Tinker's Branch
Park Lake
Village Green
Chimney Hill
Bosque
Lover's Leap
Windmill Hill
Hillcrest
Landon Branch
Braemer
Deerwood
Mouth of the Bosque
Cameron Park 2
Lindsey Hollow
Cameron Park
Redwood Shelter
Pecan Bottoms
Wooded Acres
Inverness
Mt. Carmel
Mt. Selma
Lake Shore
Ridgewood
Woodway
Tx State Little League
FM 434
Main
Cottonwood
Syrian Club
WMARSS CENTRAL WASTEWATER TREATMENT PLANT
Ledgestone
Riverside
Buckingham
River Park
Hwy 84 Lawyer
Harris Creek
Stone Creek
Twin Rivers
Church Road
Cloice Creek
Arrowhead
Flat Creek

LEGEND

- Barron's Branch (BB)
- Bosque River (BR)
- Brazos (BZ)
- Carver (CR)
- Cottonwood (CW)
- Flat Creek (FC)
- Martin Luther King (MLK)
- Primrose (PR)
- Speegleville (SP)
- Twin Bridges (TB)
- Village Lake (VL)
- City of Waco Gravity
- City of Waco Force Main
- WMARSS Gravity
- WMARSS Force Main
- City of Waco Lift Station
- WMARSS Lift Station

CITY OF WACO

N.T.S.

Figure 2-7: Lift Station Schematic

Table 2-8: Lift Station Summary

	Lift Station Name	Design Capacity[1]	Original Construction Date[2]	Basin
1	Arrowhead	175 gpm	2001	Flat Creek
2	Avon	250 gpm	1996	Carver
3	Bosque	2250 gpm	Rehab 2005	Bosque River
4	Bosqueville	Unknown	1977	Carver
5	Braemar	Unknown	TBD	Barron's Branch
6	Buckingham	250 gpm	2003	Speegleville
7	Cameron Park	30 gpm	TBD	Barron's Branch
8	Cameron Park 2	Unknown	2004	Barron's Branch
9	Chicken Shack	125 gpm	1978	MLK
10	Chimney Hill	Unknown	TBD	Bosque River
11	China Spring	200 gpm	1997	Village Lake
12	Church Road	1100 gpm	2000	Flat Creek
13	Cloice Creek	300 gpm	2011	Flat Creek
14	DAF Plant	600 gpm	2011	Bosque River
15	Deerwood	Unknown	1992	Barron's Branch
16	Falcon Pointe	210 gpm	2006	Carver
17	Flat Rock	365 gpm	1992	Village Lake
18	FM 185	200 gpm	2007	Village Lake
19	FM 434	270 gpm	2010	Cottonwood
20	Greenleaf	570 gpm	1974	Bosque River
21	Harris Creek	Unknown	2005	Speegleville
22	Hillcrest	400 gpm	1971	Barron's Branch
23	Hwy 84 Lawyer	30 gpm	2011	Speegleville
24	Inverness	Unknown	1996	Twin Bridges
25	Key's Creek	175 gpm	1998	Carver
26	Lake Shore	850 gpm	Pre 1970	Twin Bridges
27	Landon Branch	2110 gpm	Rehab 1988	Barron's Branch
28	Ledgestone	Unknown	2008	Speegleville
29	Lincoln Park	380 gpm	Pre 1980	MLK
30	Lindsey Hollow	830 gpm	TBD	Barron's Branch
31	Lover's Leap	48 gpm	2010	Barron's Branch
32	Mammoth Site	105 gpm	TBD	Carver
33	McLennan County Jail	145 gpm	2007	MLK
34	Mouth of Bosque	48 gpm	2010	Bosque River
35	Mt. Carmel	Unknown	2007	Twin Bridges
36	Mt. Selma	52 gpm	1992	Twin Bridges
37	Park Lake	Unknown	1961	Bosque River
38	Parkview	155 gpm	2006	Carver
39	Paul Quinn	Unknown	TBD	MLK
40	Pioneer Pkwy	Unknown	2007	Carver

	Lift Station Name	Design Capacity(1)	Original Construction Date(2)	Basin
41	Pecan Bottoms	Grinder	2007	Barron's Branch
42	Redwood Shelter	48 gpm	2010	Barron's Branch
43	Ridgewood	125 gpm	1993	Twin Bridges
44	Riverbend Ball Fields	Grinder	2003	Carver
45	River Park	Unknown	2006	Speegleville
46	Riverside	475 gpm	2006	Speegleville
47	Stone Creek	175 gpm	2005	Speegleville
48	Syrian Club	200 gpm	1980	Cottonwood
49	The Landing	133 gpm	2004	Carver
50	Tinker Branch	Grinder	1983	Bosque River
51	TSTC	500 gpm	1991	MLK
52	Twin Rivers	750 gpm	2001	Speegleville
53	Tx State Little League	Unknown	2001	Primrose
54	Village Green	650 gpm	1970	Bosque River
55	Village Lake	600 gpm	1974	Village Lake
56	Windmill Hill	125 gpm	1971	Barron's Branch
57	Wooded Acres	1050 gpm	1999	Twin Bridges
58	South Fork	Unknown	2013	MLK

(1) Firm Capacity based on Utility records, Mfg records and/or field verification
(2) or Last Rehabilitation Date. Obtained from Record Drawings or provided by Water Utilities staff

2.2.5. Miscellaneous System Features

Figure 2-8 shows locations of various aerial crossings and siphons found within Waco's wastewater collection system.

The locations shown are based upon the following criteria: 1) review of record drawings for all pipes 12-inch in diameter and greater, and 2) meeting with Water Utilities field staff to obtain information as to locations that are problematic on an ongoing basis. Water Utilities provided a list of siphons that are maintained on a regular basis through the City's HTE work order database.

The final listing of locations shown on Figure 2-8 is not meant to be inclusive of every aerial crossing or siphon within the collection system. There are likely many more that were not captured as part of this effort, but the City does not have a way to identify the locations of these facilities. It is critical to capture the shown locations to assist in the future proposed improvements and prioritization effort in order to determine if some of these locations can be removed, relocated, or abandoned as part of the identified improvements. Aerial crossings carry with them an increased environmental risk. During wet weather events, water and debris loads can compromise the aerial crossing line resulting in raw sewage being released directly into the corresponding creek or waterway. Therefore, removal, relocation or abandonment of the high risk crossings is advantageous to the City.

2.3 Identification of Problem Areas, Structurally Deficient Segments and Lift Stations

A series of meetings were held with Utilities & Engineering staff, lift station staff and collection system staff to discuss historical / institutional knowledge of both system wide structural deterioration / failure and inadequate hydraulic capacity "hot spot" areas.

2.3.1. Background

The Team and City staff participated in a series of meetings with key Utilities & Engineering staff, lift station staff and collection system staff to discuss the staff's historical / institutional knowledge of both system structural deterioration/failures and inadequate hydraulic capacity "hot spot" areas that have been identified. **These are recurrent problems that have not been appropriately remediated to date.**

2.3.2. Wastewater Collection System

City staff identified a total of 51 "projects" that were established as recurrent high priority problem areas. These are in need of replacement/repair for structural and/or capacity issues. These projects have been identified as necessary asset renewal projects and are included within the various figures included within the following sections.

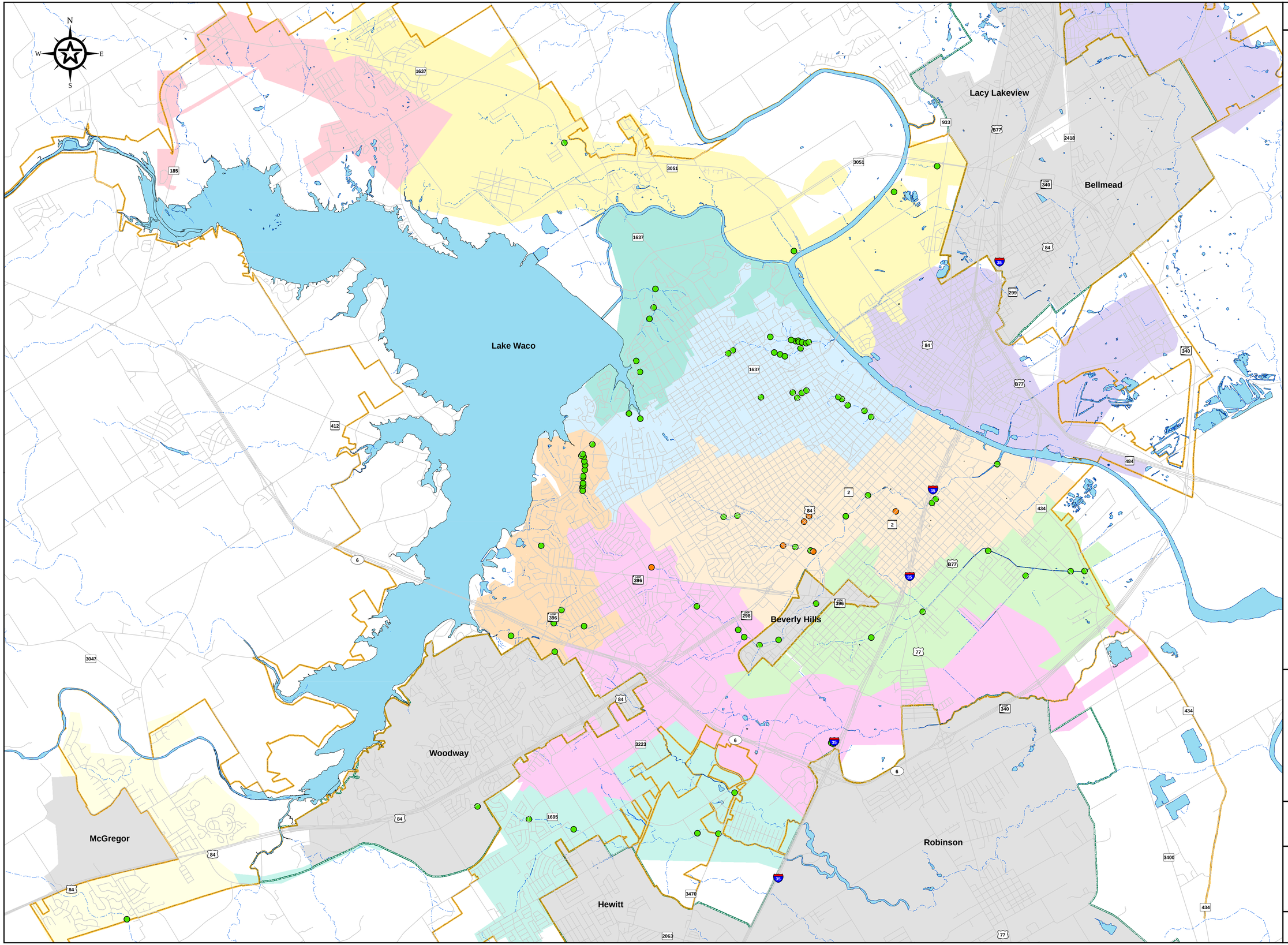
It should be noted that the presentation of the information that resulted in the identification of the 51 problem areas in the collection system is not intended to be an inclusive or exhaustive list. Much of the information should be vetted through traditional technical and engineering methods. The information does, however, gather in one place and at one time the collective knowledge and experience of the personnel charged with the operation, design, and maintenance of the collection system.

The Team reviewed a cross section of historical City of Waco work order data in an effort to correlate the effort expended by City forces in response to these 51 problem areas. The review efforts provided a weak correlation between problem areas identified and the volume of work orders issued and executed by City staff. Based upon the historical work order information that was reviewed, greater than 60% of the City's work order efforts are concentrated within the Barron's Branch, Brazos and Cottonwood wastewater basins. This is primarily attributed to the fact that these basins are generally located within the older and more established portions of the City. However, only 22 of the 51 City identified projects (43%) were located within these 3 basins. This is a smaller percentage than originally anticipated.

The 51 "One Page City Identified Summary Project Forms" gathered the collective knowledge and experience of the Water Utilities personnel charged with the operation, design and maintenance of the collection system in one place and at one time.

Based upon the information gathered as part of the meetings, fifty-one (51) "One Page City Identified Summary Project Forms" were developed. These forms are included as part of Appendix A.

In the pages that follow, the data garnered from the series of meetings is summarized and graphically presented.



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- Aerial Crossing
- Siphon
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 2-8: Aerial Crossing & Siphon Map

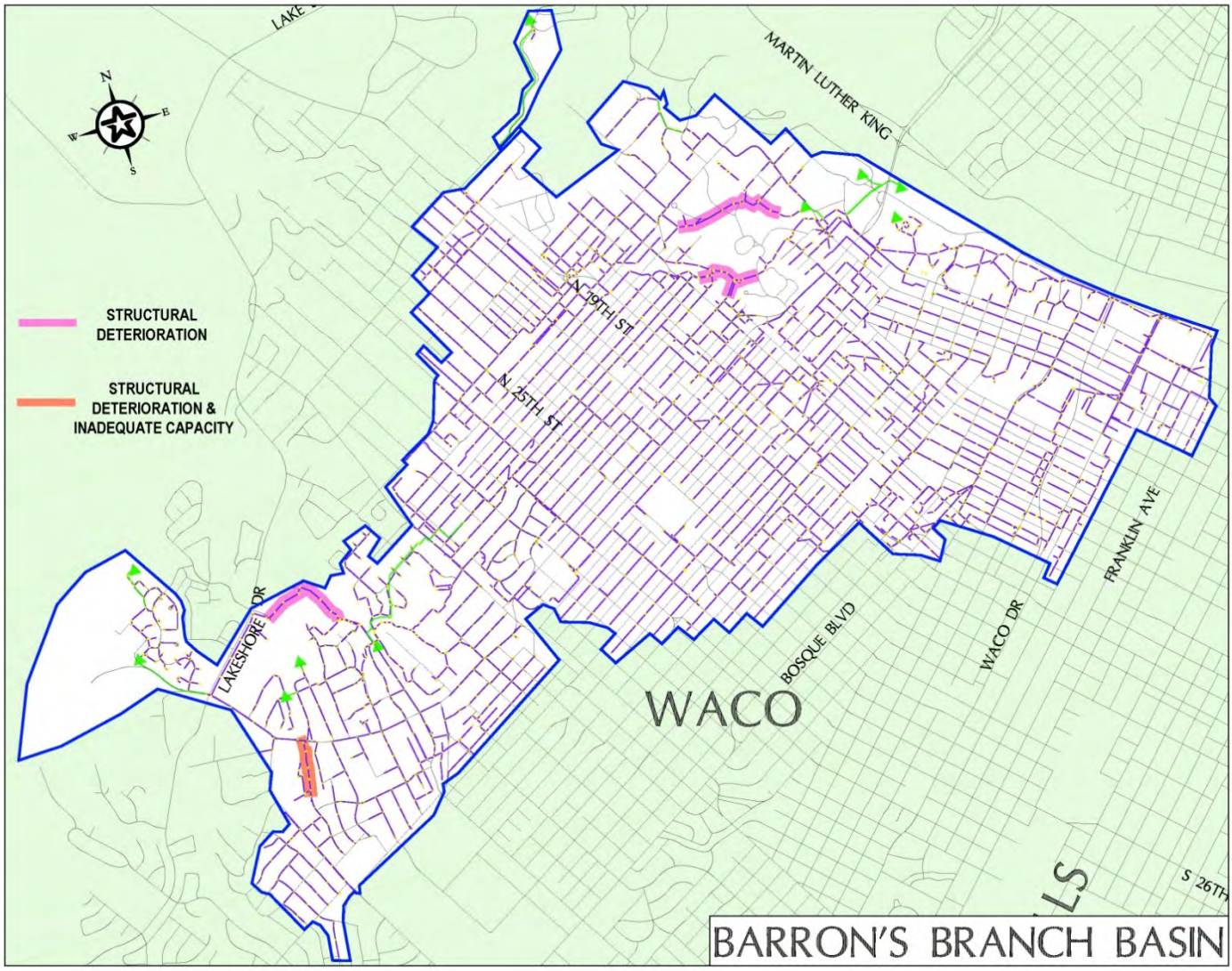
G:\GIS\Projects\1-02231\Maps\Aerial-Siphon Map.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

2.3.2.1 Barron's Branch Basin

The total area of this basin is approximately 6.0 square miles which is 7.7% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Barron's Branch Basin: Hillcrest, Windmill Hill, Deerwood, Braemar, South Landon Branch, Landon Branch, Lover's Leap, Cameron Park 2, Lindsey Hollow, Cameron Park, Redwood Shelter, Pecan Bottoms, and Barron's Branch. Approximately 15.1% (565,000 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 4 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 11 lift stations and associated force mains within its service area. Approximately 26.6% of the City's work order related activities from 2009 to 2013 were located within this basin. Historically, the City has experienced numerous FOG (Fats, Oils and Grease) problems in the area upstream of Lindsey Hollow Road.

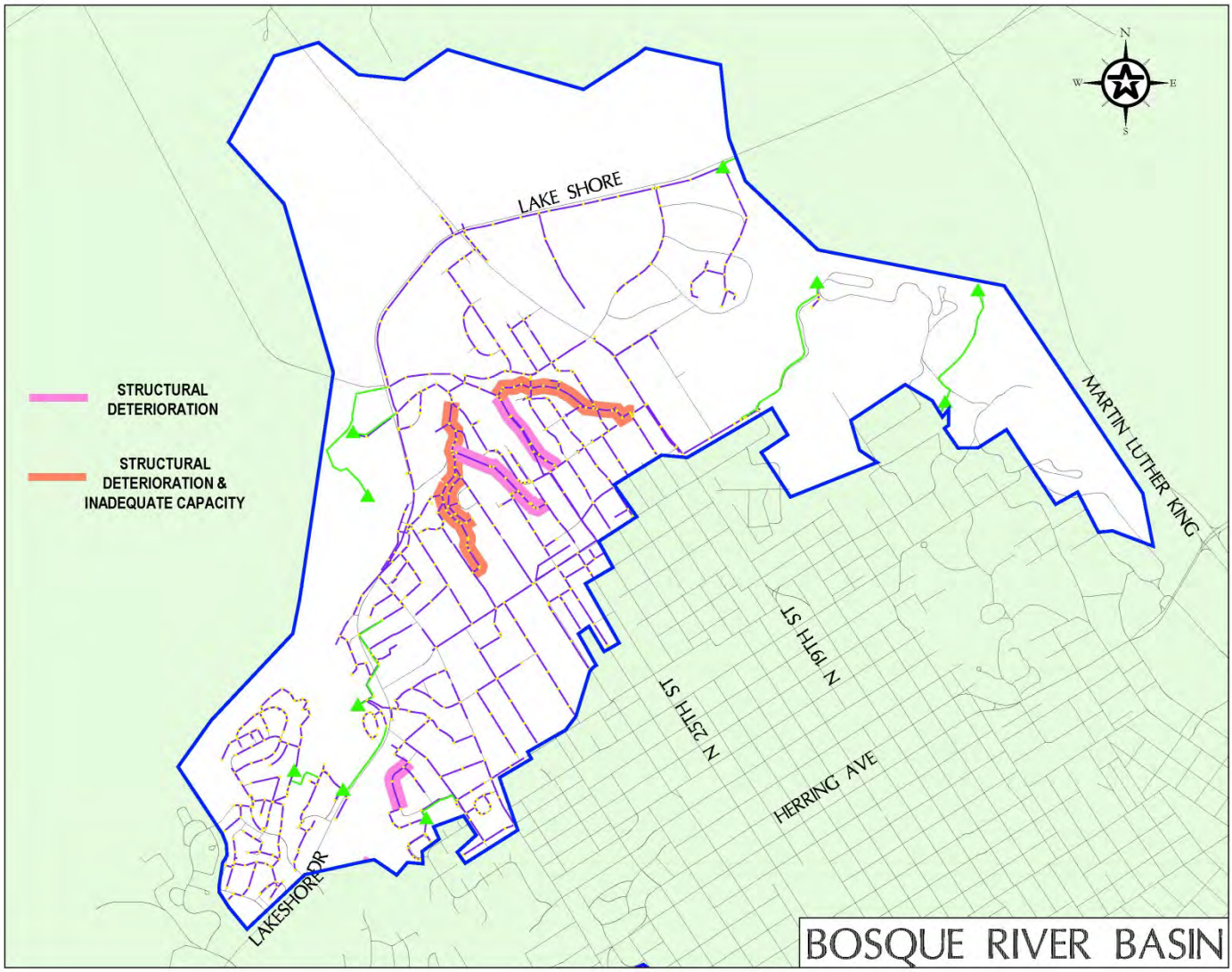
Figure 2-9: Barron's Branch Basin



2.3.2.2 Bosque River Basin

The total area of this basin is approximately 3.9 square miles which is 5.0% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Bosque River Basin: Greenleaf Peninsula, Village Green, Chimney Hill, Park Lake, DAF, Tinker's Branch, Mouth of the Bosque, and Bosque. Approximately 4.3% (161,600 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 5 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 8 lift stations and associated force mains within its service area. Approximately 4.1% of the City's work order related activities from 2009 to 2013 were located within this basin.

Figure 2-10: Bosque River Basin

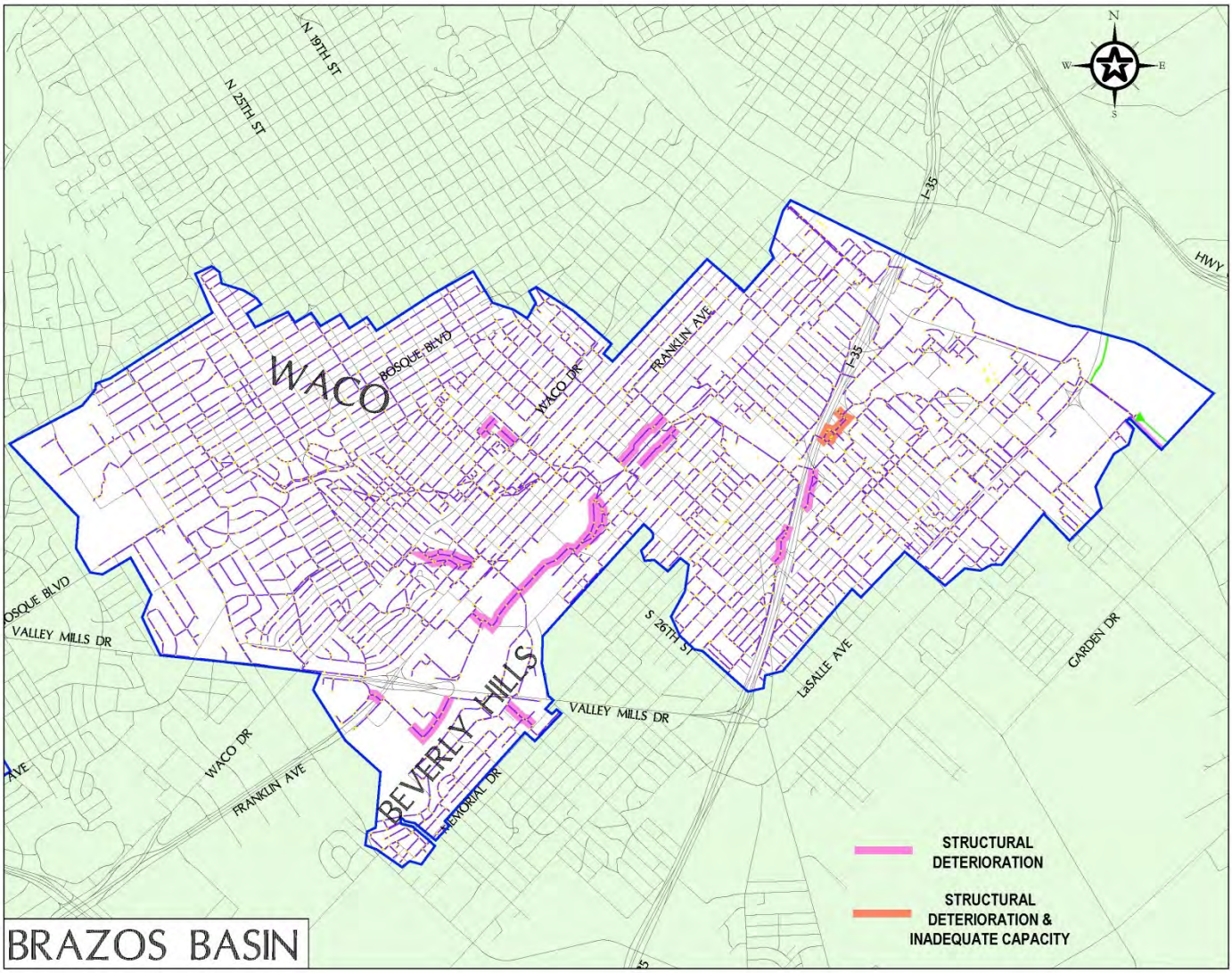


2.3.2.3 Brazos Basin

The total area of this basin is approximately 8.7 square miles which is 11.2% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Brazos Basin: Waco Creek North, Waco Creek South, and Brazos. Approximately 20.6% (768,700 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 12 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin has no lift stations or associated force mains within its service area. Approximately 27.1% of the City's work order related activities from 2009 to 2013 were located within this basin.

In 2003, the City of Waco (through a consultant) conducted sonar and closed circuit TV inspection of portions of the West Bank Interceptor. It was observed that the interceptor was in fair condition north of the Riverside Water Plant and in very poor condition south of the Riverside Water Plant. The reinforced concrete pipe exhibited significant lengths of exposed aggregate and a moderate to severe buildup of silt and sediment. This condition is potentially attributed to wasted chemicals and backwash from the Riverside Water Plant operations years in the past. City staff has performed maintenance (cleaning) work along the West Bank Interceptor within the last 5 years which has improved the flow/capacity on this line.

Figure 2-11: Brazos Basin

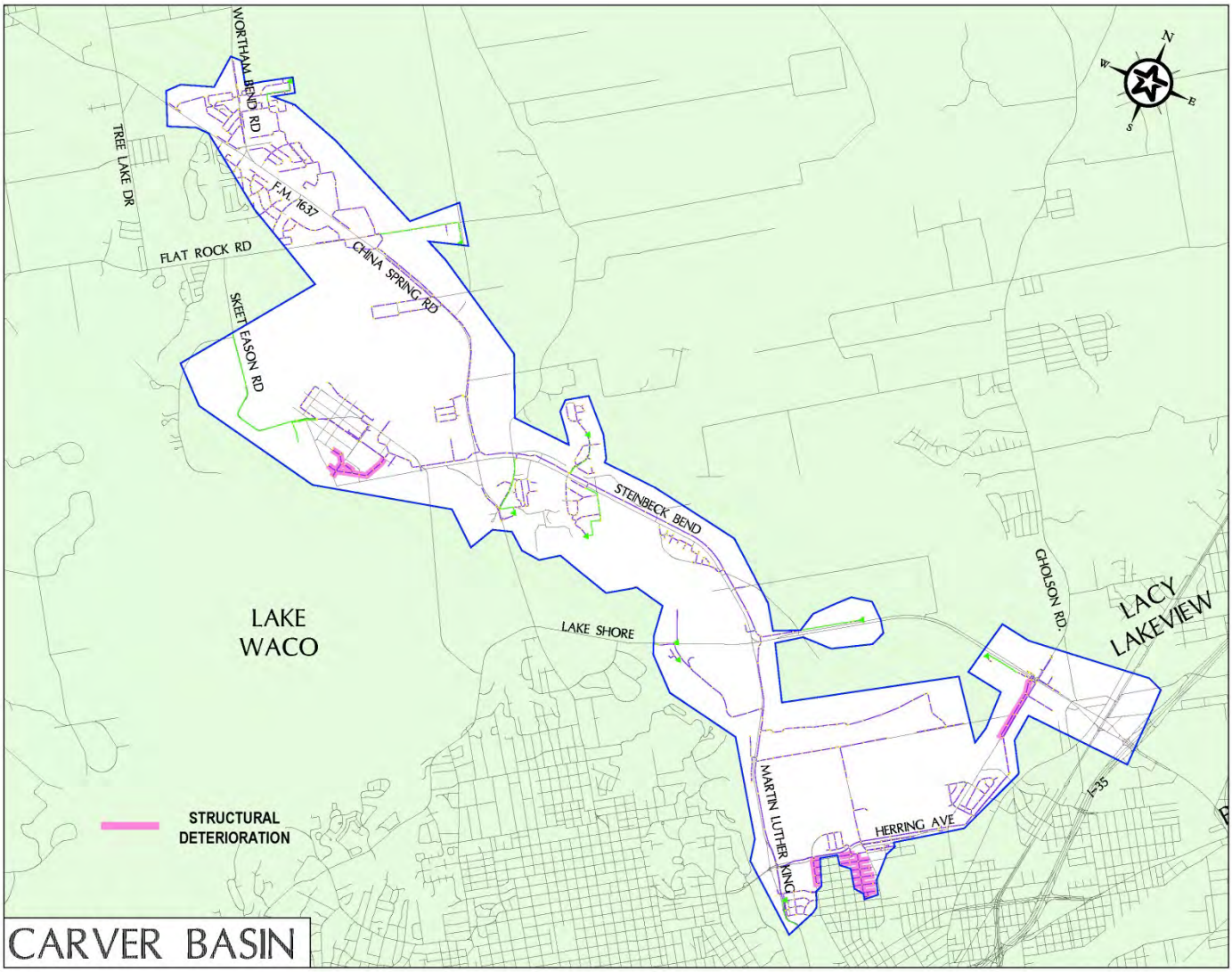


2.3.2.4 Carver Basin

The total area of this basin is approximately 11.4 square miles which is 14.7% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Carver Basin: Airport, Falcon Point, Pioneer, Bosqueville, Keys Creek, Avon, Mammoth Site, Riverbend Park, Steinbeck Bend, Landing, and Carver. Approximately 7.0% (262,600 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 4 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 9 lift stations and associated force mains within its service area. Approximately 3.1% of the City's work order related activities from 2009 to 2013 were located within this basin.

There is a WMARSS system interconnection with the City of Lacy Lakeview within the Carver Basin along Herring Avenue (WMARSS Lacy Lakeview Interceptor). The identified future WMARSS 3-10 Yr. CIP No. 2 will reroute approximately 90-95% of the wastewater flow from the City of Lacy Lakeview away from this area, thus removing existing hydraulic bottlenecks and freeing up available hydraulic capacity that is needed in the Village Lake, Carver and MLK Basins of the collection system.

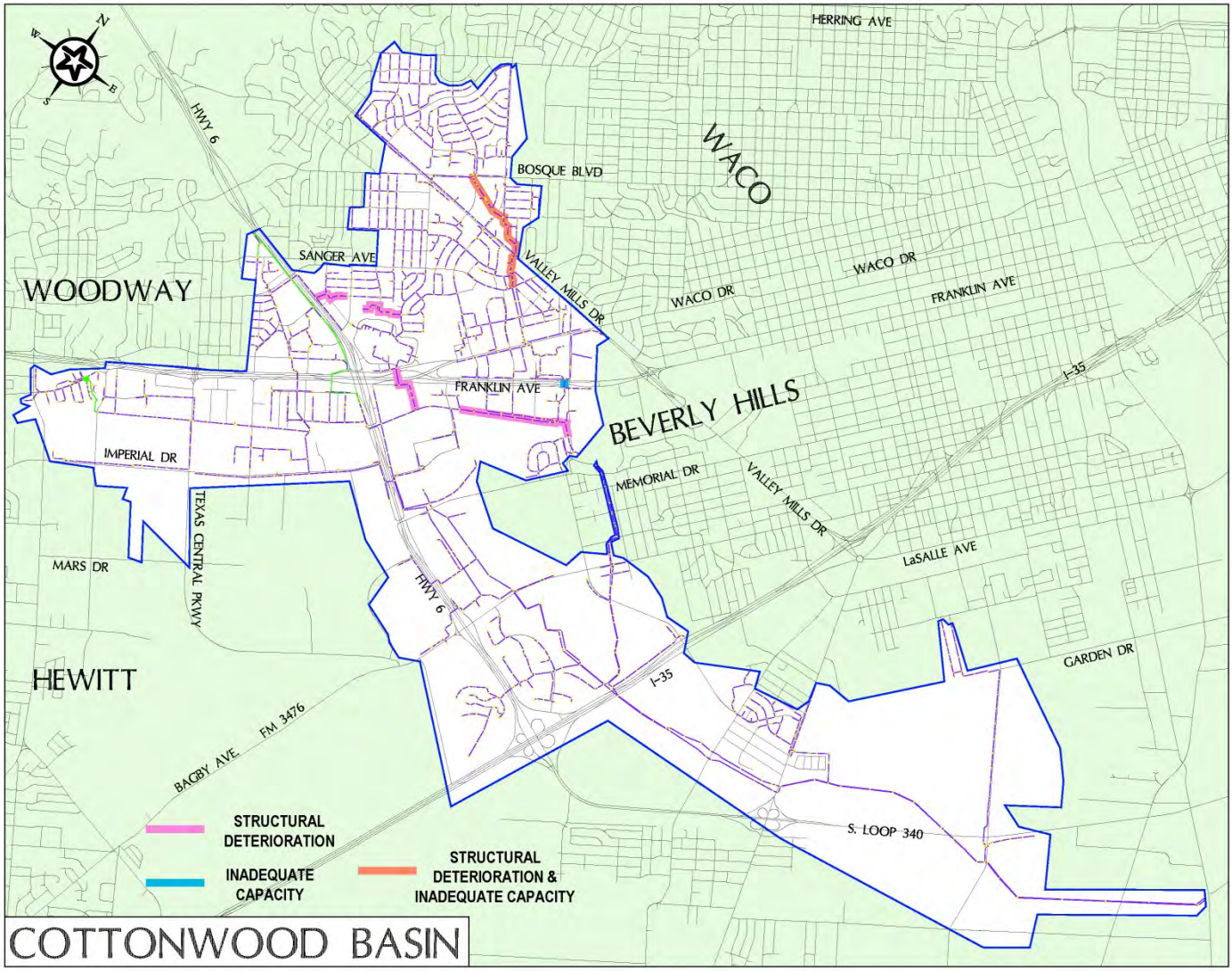
Figure 2-12: Carver Basin



2.3.2.5 Cottonwood Basin

The total area of this basin is approximately 11.5 square miles which is 14.8% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Cottonwood Basin: Syrian Club, Upper Cottonwood, South 12th, and Cottonwood. Approximately 10.7% (400,800 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 6 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 2 lift stations and associated force mains within its service area. Approximately 7.9% of the City's work order related activities from 2009 to 2013 were located within this basin. The City has two aerial crossings located near Greer Drive and North Valley Mills Drive that are problematic. There is also an existing siphon near the intersection of Sanger Avenue and North Valley Mills Drive around Waco Creek that is problematic. The area around Franklin Avenue and South New Road has historically required attention by Utilities staff, especially the 18-inch gravity line that crosses Franklin Avenue. City staff has placed a permanent plug on the 24" Waco Creek line (at Hiland reroute manhole) so that flows can only be routed towards the WMARSS Cottonwood interceptors. There are system interconnections with the City of Woodway in this basin. Both Waco and Woodway route flows to the WMARSS Woodway Lift Station that are then routed through the Cottonwood Basin via the WMARSS Cottonwood interceptors.

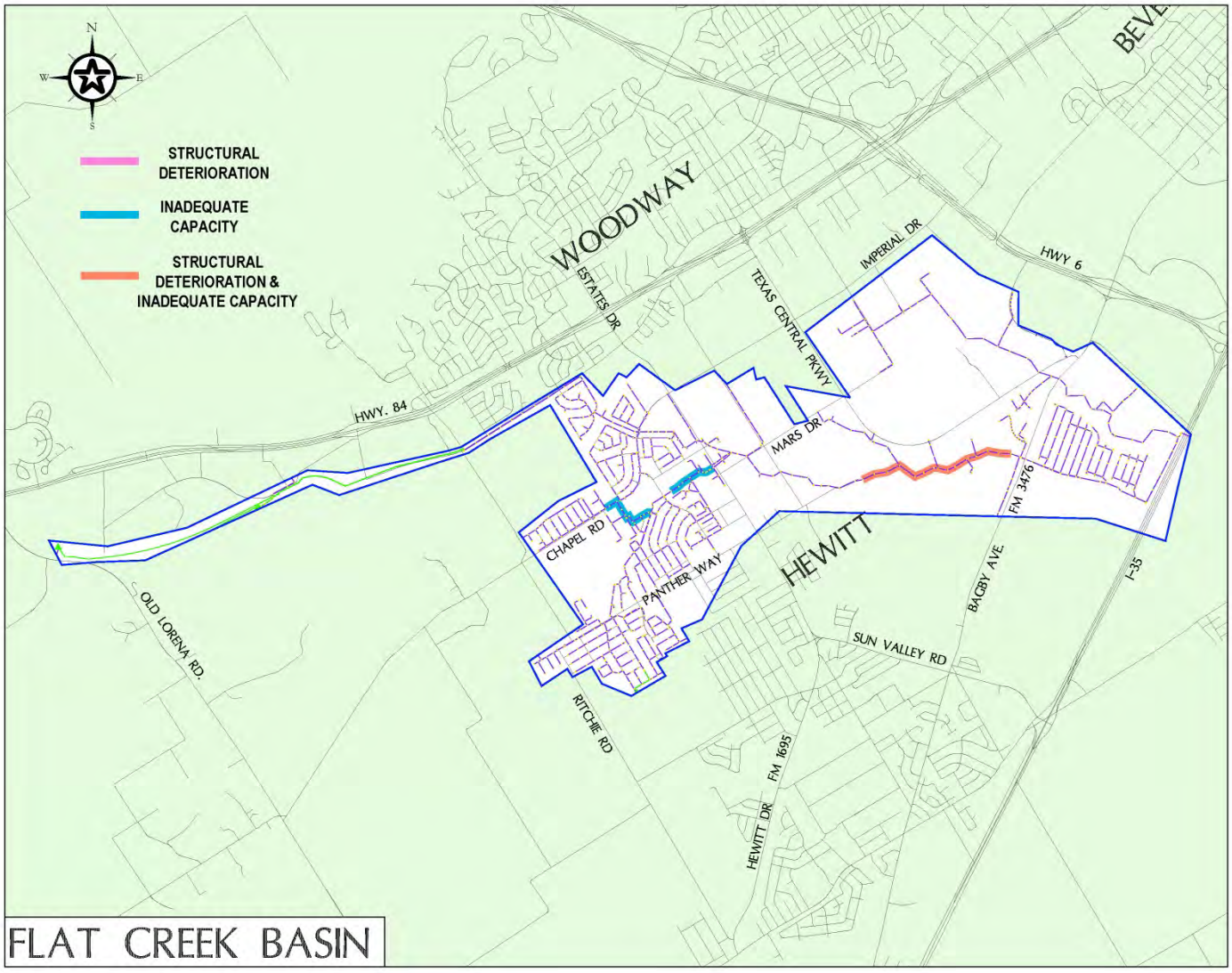
Figure 2-13: Cottonwood Basin



2.3.2.6 Flat Creek Basin

The total area of this basin is approximately 6.0 square miles which is 7.7% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Flat Creek Basin: Church, Cloice Creek, Arrowhead, Panther Way, North Flat Creek, and Flat Creek. Approximately 6.8% (252,200 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 3 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 3 lift stations and associated force mains within its service area. Approximately 2.2% of the City's work order related activities from 2009 to 2013 were located within this basin.

Figure 2-14: Flat Creek Basin

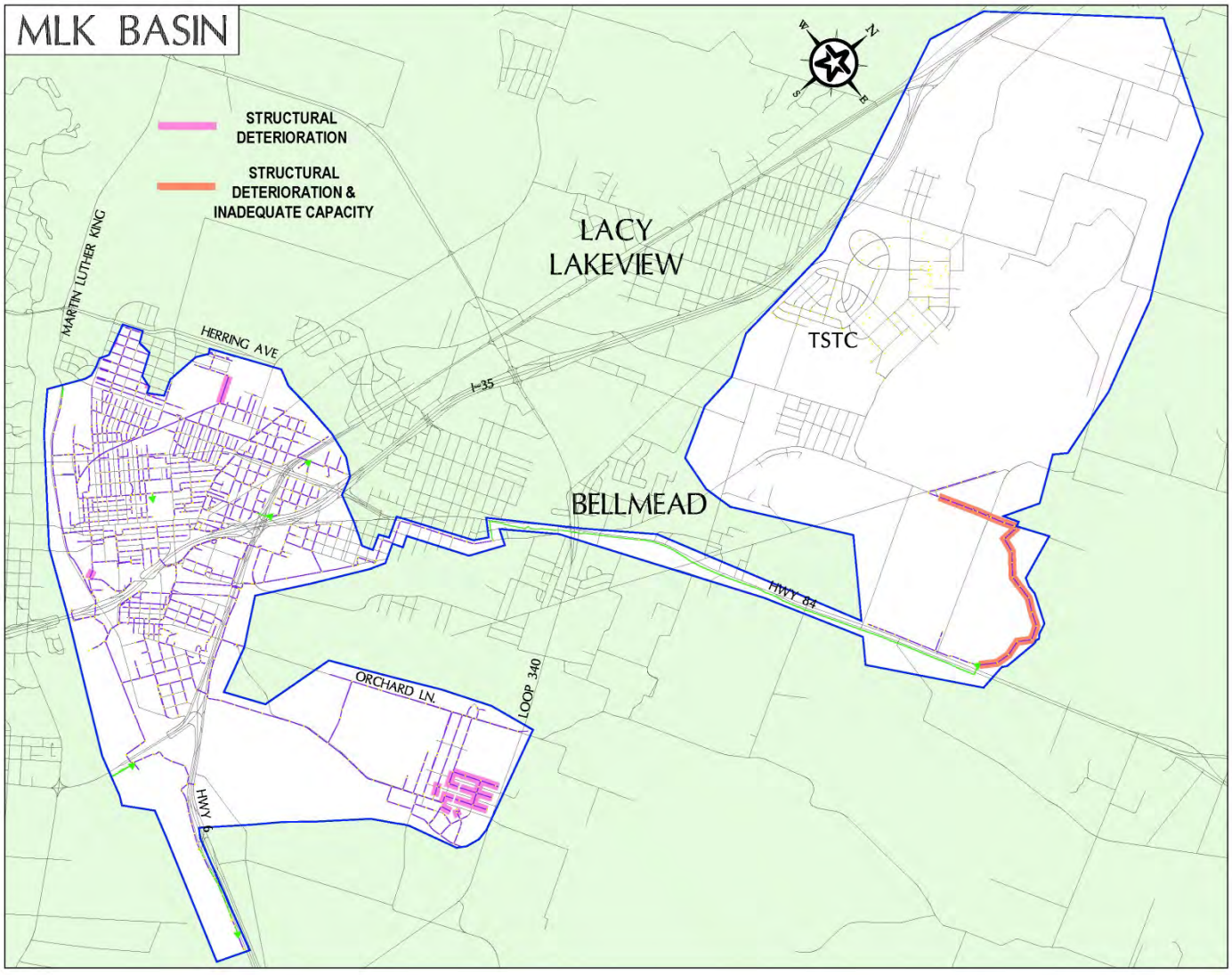


2.3.2.7 MLK Basin

The total area of this basin is approximately 14.7 square miles which is 18.9% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the MLK Basin: TSTC, West MLK, Chicken Shack, Lincoln Park, East MLK, and McLennan County Jail. Approximately 9.6% (359,700 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 4 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 5 lift stations and associated force mains within its service area. Approximately 10.0% of the City's work order related activities from 2009 to 2013 were located within this basin.

There is a WMARSS system interconnection with the City of Bellmead within the MLK Basin along East Clay Avenue, the Railroad and ending at Hogan Lane (WMARSS Bellmead Interceptor). The identified future WMARSS 3-10 Yr. CIP Project No. 2 will reroute approximately 55-60% of the wastewater flow from the City of Bellmead and 100% of the wastewater flow from the TSTC area away from this basin, thus removing existing hydraulic bottlenecks and freeing up available hydraulic capacity that is needed in the Village Lake, Carver, and MLK Basins of the collection system.

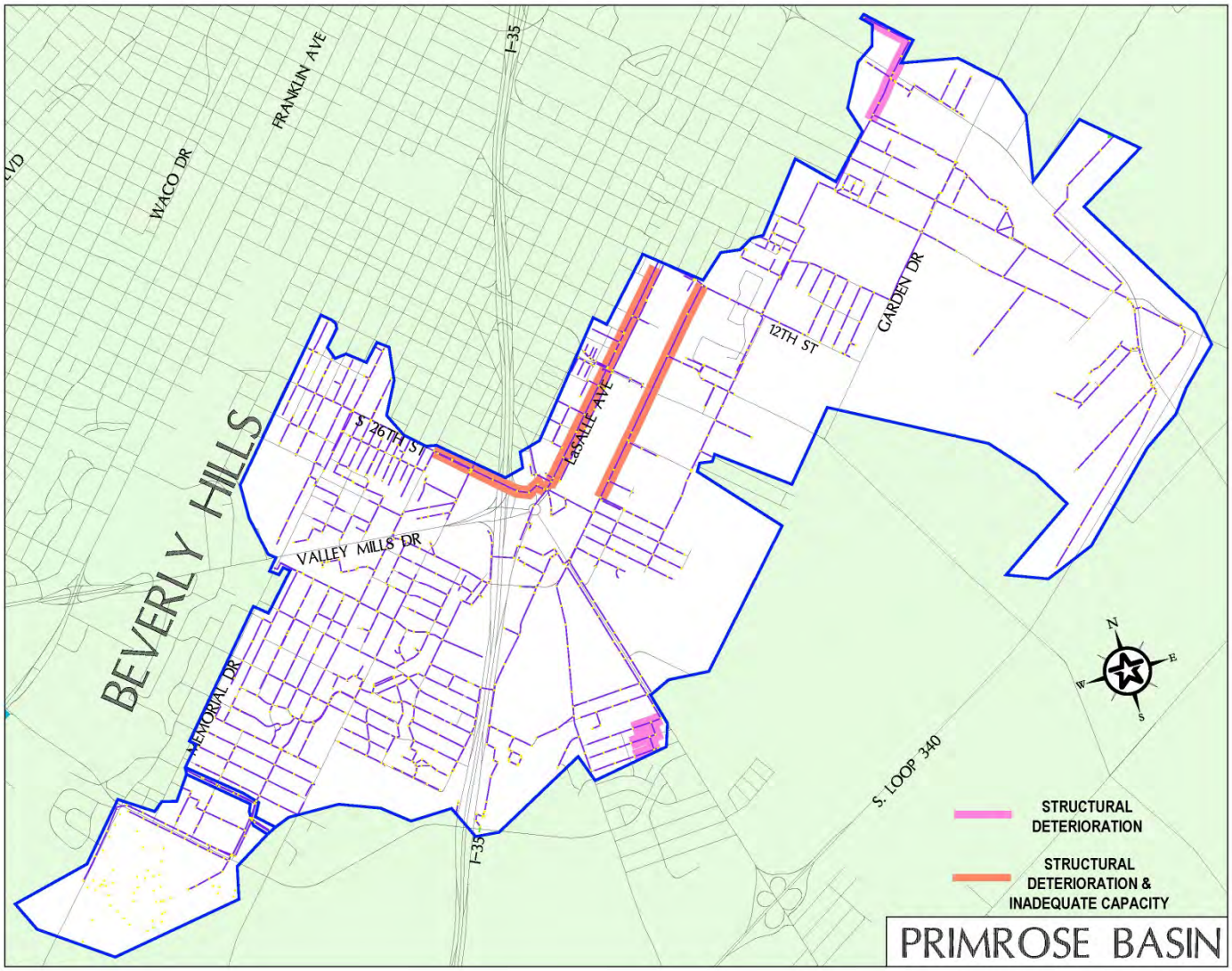
Figure 2-15: MLK Basin



2.3.2.8 Primrose Basin

The total area of this basin is approximately 5.3 square miles which is 6.8% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Primrose Basin: VA, South Primrose, West Primrose, Texas State Little League, and Primrose. Approximately 3.0% (111,100 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 5 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 1 lift station and associated force main within its service area. Approximately 11.0% of the City's work order related activities from 2009 to 2013 were located within this basin.

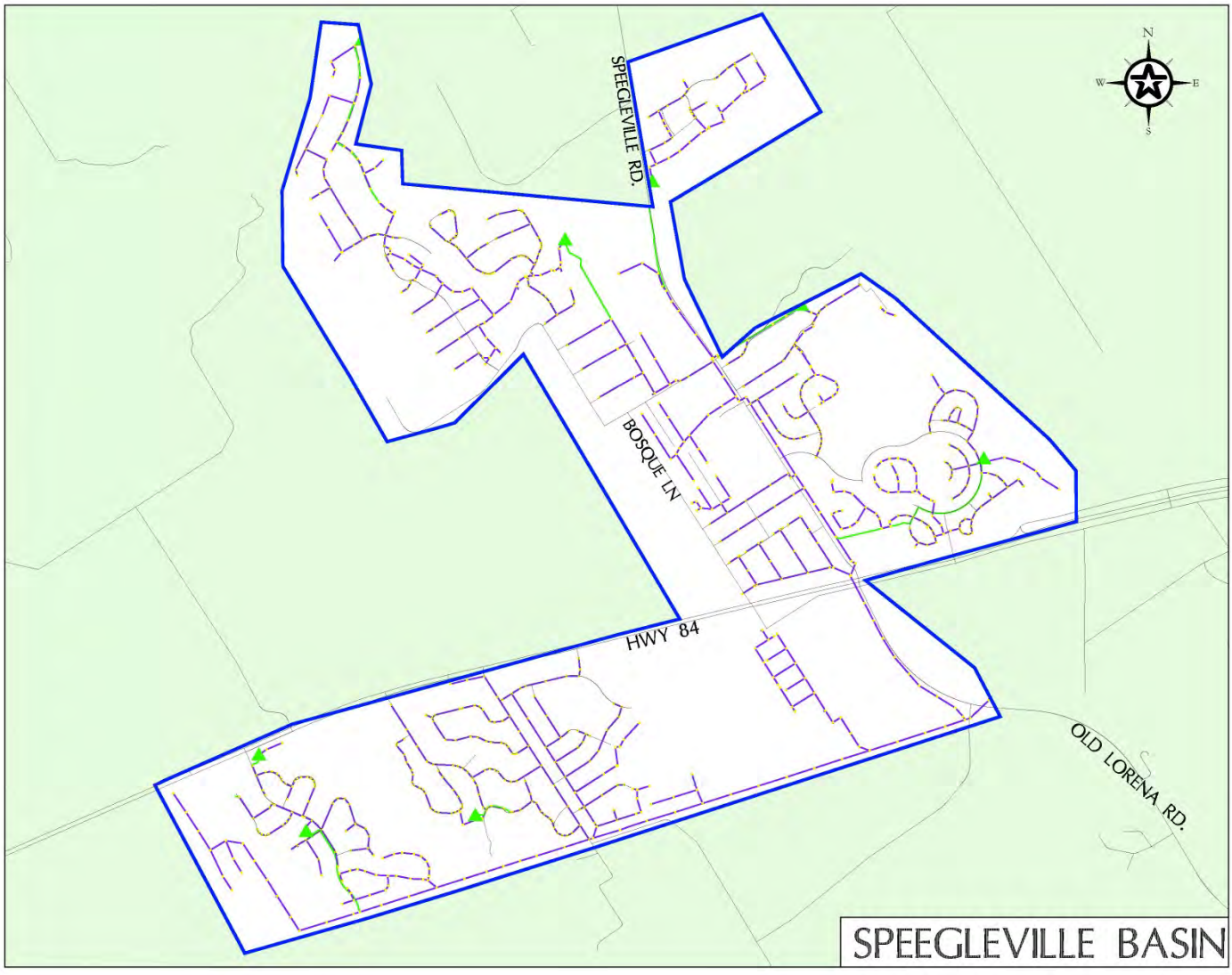
Figure 2-16: Primrose Basin



2.3.2.9 Speegleville Basin

The total area of this basin is approximately 3.9 square miles which is 5.0% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Speegleville Basin: 84 Lawyer, Stone Creek, Harris Creek, Ledgestone, Buckingham, Riverside, River Park, Twin Rivers, and Speegleville. Approximately 2.0% (72,800 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified no asset renewal projects within this basin. This basin contains 8 lift stations and associated force mains within its service area. Approximately 0.7% of the City's work order related activities from 2009 to 2013 were located within this basin.

Figure 2-17: Speegleville Basin

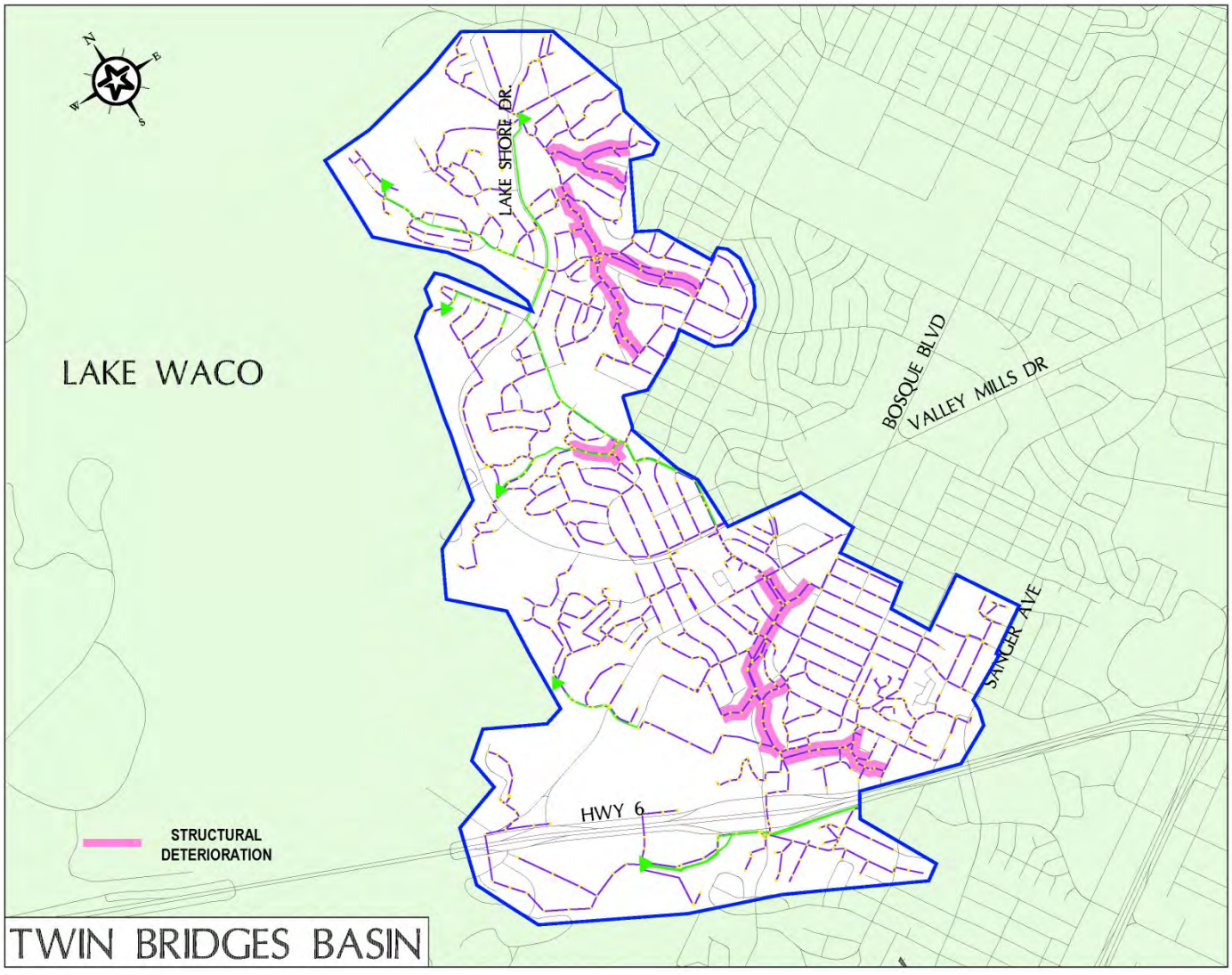


2.3.2.10 Twin Bridges Basin

The total area of this basin is approximately 3.1 square miles which is 4.0% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Twin Bridges Basin: Inverness, Wooded Acres, Mt. Selma, Lake Shore, Ridgewood, and Twin Bridges. Approximately 8.1% (301,700 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified 8 asset renewal projects within this basin due to structural deterioration and/or inadequate hydraulic capacity. This basin contains 6 lift stations and associated force mains within its service area. Approximately 6.4% of the City's work order related activities from 2009 to 2013 were located within this basin.

A study and rehabilitation plan was developed for the Wooded Acres sub-basin in 2011.

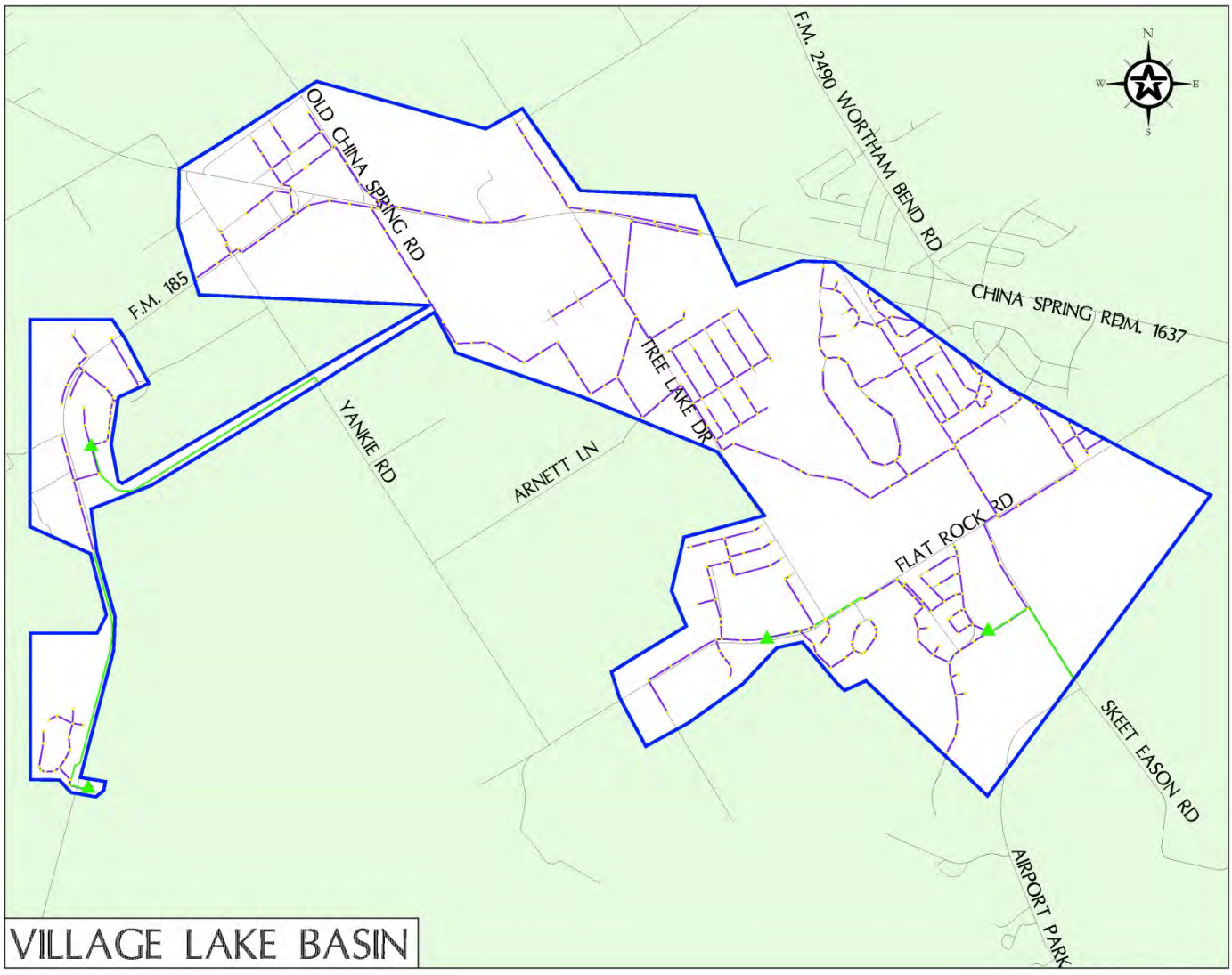
Figure 2-18: Twin Bridges Basin



2.3.2.11 Village Lake Basin

The total area of this basin is approximately 3.3 square miles which is 4.2% of the approximately 77.8 square miles serviced by the City of Waco. The following sub-basins are included within the Village Lake Basin: FM 185, China Spring, Yankie, Flat Rock, and Village Lake. Approximately 4.7% (176,700 LF) of the City of Waco wastewater collection system pipeline is located within this basin. Collection system staff has identified no asset renewal projects within this basin. This basin contains 4 lift stations and associated force mains within its service area. Approximately 0.9% of the City's work order related activities from 2009 to 2013 were located within this basin. City staff noted that the existing Village Lake lift station has capacity to accommodate the average daily flows, but is significantly undersized during wet weather events. The City is currently working to upsize the sewer line along FM 1637 north of Steinbeck Bend.

Figure 2-19: Village Lake Basin



It is noted that there is approximately 1.7% (62,900 LF) of the collection system that is classified as being "Outside Basins" within the City's GIS system.

2.4 Summary / Prioritization of City Identified Gravity Segment Deficiencies

The information and data gathered as a part of this effort indicates that widespread operational and capacity issues exist in the City of Waco wastewater collection system despite the City's efforts**. It should be noted that the ownership, operation and maintenance of a wastewater collection system is a task without a conclusion. The owners of wastewater collection systems strive to maintain a certain level of system performance, such that the system provides an appropriate level of service to the public at large. To that end, the City of Waco has acted in the best interest of the public by engaging in more than 20 sewer system studies and the associate rehabilitation efforts since 1992.** These have resulted in the design, rehabilitation and construction of 1.56 million linear feet of service mains of various sizes, the development of $18.7 M capital improvement programs, and the expenditure of more than $19.2 M in operation and maintenance costs.

During the data gathering portion of this effort, more than 51 areas of the collections system were identified by City staff as being substandard and in need of repair, rehabilitation or replacement. More than half of these projects are focused on pipe segments and other O&M issues that are outside of the scope of the current Wastewater Master Plan for various reasons. While these projects are not necessarily the focus of the Master Plan, they are extremely important to the overall performance of the collection system. More than 75,000 linear feet of 6-inch, 8-inch and 10-inch pipelines have been identified for replacement or renewal. It is important to note that more than 90% of the 75,000 linear feet of pipeline identified in the 51 asset renewal projects is comprised of 50+ year old vitrified clay pipe. Included within the asset renewal, **City staff identified twelve (12) aerial crossing locations that routinely are problematic for the field operations staff.**

City staff identified more than 75,000 linear feet of 6-inch, 8-inch and 10-inch pipelines that are in need of immediate replacement or renewal. A majority of this pipe is comprised of 50+ year old vitrified clay pipe.

The City of Waco is urged to assign appropriate priorities and include these sanitary sewer renewal projects within the Capital Improvement Program. Table 2-9 provides a 2014 independent ranking by City staff and Team members of these asset renewal projects.

Table 2-9: Asset Renewal Project Ranking

Project Number (Major Basin)	Prioritization Number	As-Built Date / Pipe Material	Noted Condition	Dia. Range (IN)	Length (FT)
BB-1 (Barron's Br)	41	1955/VCP	Structural Deterioration & Inadequate Capacity	12	1,220
BB-2 (Barron's Br)	6	1969/VCP	Structural Deterioration	15	2,050
BB-3 (Barron's Br)	30	1968/VCP, 1988/PVC	Structural Deterioration	12, 21	2,020
BB-4 (Barron's Br)	13	?	Structural Deterioration	12	2,360
BR-1 (Bosque River)	49	1967/VCP	Structural Deterioration	8	940
BR-2 (Bosque River)	1	1955/VCP	Structural Deterioration & Inadequate Capacity	8, 12	4,660
BR-3 (Bosque River)	12	1955/VCP	Structural Deterioration	8	1,950
BR-4 (Bosque River)	23	1955/VCP	Structural Deterioration	8	1,620
BR-5 (Bosque River)	36	1955/VCP	Structural Deterioration & Inadequate Capacity	12	2,630
BZ-1 (Brazos)	45	1976/VCP	Structural Deterioration	8	860
BZ-2 (Brazos)	14	?/CIP	Structural Deterioration	12	370
BZ-3 (Brazos)	48	?/VCP	Structural Deterioration	12	1,670
BZ-4 (Brazos)	24	?/VCP	Structural Deterioration	8-36	6,890
BZ-5 (Brazos)	3	?/VCP	Structural Deterioration	8, 12	2,480
BZ-6 (Brazos)	15	?	Structural Deterioration	8, 12	790
BZ-7 (Brazos)	40	?/VCP	Structural Deterioration	8	320
BZ-8 (Brazos)	32	?	Structural Deterioration	15	1,670
BZ-9 (Brazos)	33	?	Structural Deterioration	8	1,340
BZ-10 (Brazos)	26	?/VCP	Structural Deterioration	12	1,080
BZ-11 (Brazos)	43	1964/VCP	Structural Deterioration	8, 12	1,000
BZ-12 (Brazos)	34	1964/VCP	Structural Deterioration & Inadequate Capacity	8, 12	1,470
CR-1 (Carver)	29	1944/VCP, 1983/PVC	Structural Deterioration	8, 12	4,590
CR-2 (Carver)	7	?/VCP,CIP	Structural Deterioration	8	2,160
CR-3 (Carver)	18	1964/VCP	Structural Deterioration	8	6,260
CR-4 (Carver)	47	1997/PVC	Structural Deterioration	18	2,710
CW-1 (Cottonwood)	28	1970/VCP	Structural Deterioration	8, 12	1,240
CW-2 (Cottonwood)	35	?	Structural Deterioration	8	1,850
CW-3 (Cottonwood)	4	1956/VCP, 1991/PVC	Structural Deterioration & Inadequate Capacity	15, 21	4,670
CW-4 (Cottonwood)	21	1964/CIP	Structural Deterioration	12	1,670
CW-5 (Cottonwood)	42	1961/VCP	Structural Deterioration	18, 24	4,230
CW-6 (Cottonwood)	38	1954/VCP	Inadequate Capacity	21	310
FC-1 (Flat Creek)	22	?/1984, ?/1988	Structural Deterioration	8	2,170
FC-2 (Flat Creek)	51	?/2008	Inadequate Capacity	21	1,590
FC-3 (Flat Creek)	11	1975/VCP	Structural Deterioration & Inadequate Capacity	21, 24	5,550
MLK-1 (Mar. Lth. King)	31	?/VCP	Structural Deterioration	15	300
MLK-2 (Mar. Lth. King)	17	1958/VCP	Structural Deterioration	12	980
MLK-3 (Mar. Lth. King)	8	?	Structural Deterioration	8	7,120
MLK-4 (Mar. Lth. King)	46	1991/PVC	Structural Deterioration & Inadequate Capacity	21, 24	9,550
PR-1 (Primrose)	16	1954/?	Structural Deterioration & Inadequate Capacity	12	2,660
PR-2 (Primrose)	5	?	Structural Deterioration & Inadequate Capacity	18	5,210
PR-3 (Primrose)	25	1954/?	Structural Deterioration & Inadequate Capacity	24	4,850
PR-4 (Primrose)	50	?/VCP, 1987/PVC	Structural Deterioration	8	2,330
PR-5 (Primrose)	39	?	Structural Deterioration	36	3,050
TB-1 (Twin Bridges)	2	1964/VCP	Structural Deterioration	8	2,410
TB-2 (Twin Bridges)	9	1966/VCP, 1993/PVC	Structural Deterioration	8, 12	3,660
TB-3 (Twin Bridges)	10	?	Structural Deterioration	8	1,910
TB-4 (Twin Bridges)	27	?/VCP	Structural Deterioration	8	1,200
TB-5 (Twin Bridges)	37	?/VCP, 1987/PVC	Structural Deterioration	8, 24	2,670
TB-6 (Twin Bridges)	44	?/VCP	Structural Deterioration	8	750
TB-7 (Twin Bridges)	19	1956/VCP, 1990/PVC	Structural Deterioration	8, 24	1,790
TB-8 (Twin Bridges)	20	1962/?, 1971/VCP	Structural Deterioration	8	2,360

The City identified five additional areas where staff routinely experience ongoing operational and system performance issues. These areas will be closely evaluated within Chapter 8 (Proposed Improvements and Prioritization).

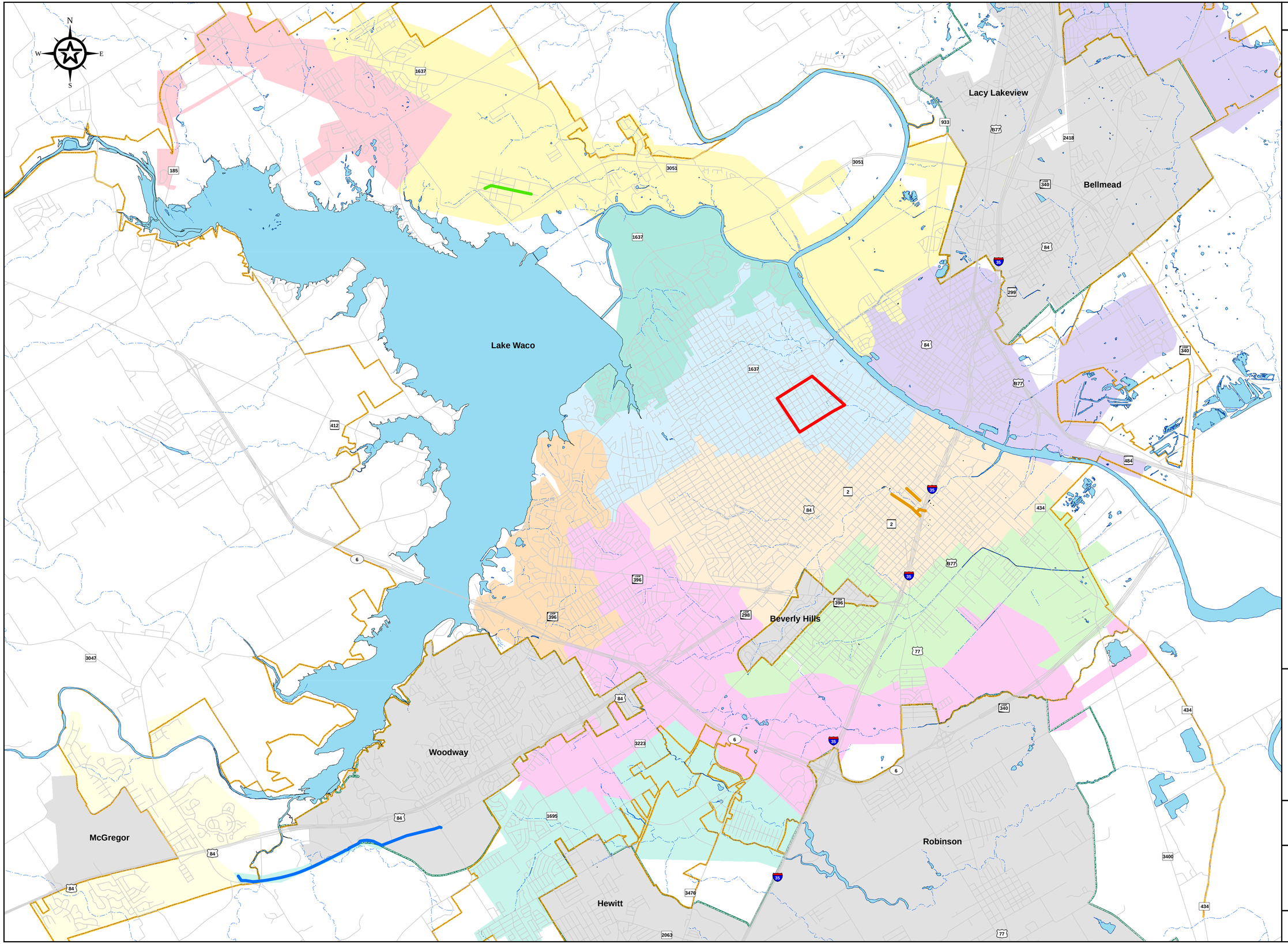
In addition to the identification of the 50+ very near term system renewal projects, the City of Waco staff identified five (5) areas of the City where ongoing operational and system performance issues exist. These areas were not scoped as part of the asset renewal projects due to the fact that they were located in areas that other significant future collection system upgrades have previously been identified. These "areas" will be closely analyzed as part of the Team's evaluations within Chapter 8 (Proposed Improvements and Prioritization. These areas are shown as part of Figure 2-20 and are described in more detail below:

Area 1 – Portion of Barron's Branch drainage basin bounded by 18th Street on the west, Live Oak Avenue on the north, 8th Street on the east, and Colcord Avenue on the south. **City staff conveyed that this area is the source of multiple and varied collection system problems.** The supposition is that because the area is very flat, the wastewater system experiences low flow velocities and deposition.

Area 2 – Portion of the Speegleville and/or Flat Creek drainage basins. The existing Church Road Lift Station force main (12-inch) was indicated to be in poor to very poor condition. **The limits identified by City staff for force main replacement has been previously identified for inclusion in a larger flow rerouting project (South Flat Creek to Bull Hide/Castleman Creek interceptor)** and will be evaluated within Chapter 8 of the Master Plan.

Area 3 – Portion of the Carver drainage basin. **The existing 10-inch & 18-inch gravity sewer mains downstream of the Village Lake Lift Station force main outfall (near the Waco Regional Airport) are known to be in poor structural condition and exhibit inadequate hydraulic capacity during wet weather events.** It is suspicioned that a storm line cross connection exists somewhere in the Village Lake drainage area and this may be the root cause of unauthorized discharges upstream of the lift station, capacity issues at the lift station, and structural issues downstream of the station. Other suspicion focused on the possible lack of pumping capacity at the current Village Lake lift station. This area (line) has been previously identified for possible inclusion in a larger project within the Master Plan and will be closely evaluated within Chapter 8.

Area 4 – Portion of the Brazos Basin. **The existing 15-inch and 18-inch gravity sewer mains located just east of Cesar Chavez Middle School from Clay Avenue to Gurley Avenue are known to be in poor structural condition and exhibit inadequate hydraulic capacity during wet weather events.** This line segment is part of a possible project identified by the Team for evaluation for capacity and hydraulic improvements within Chapter 8 of the Master Plan. The existing line diameters vary widely in this area. The Team will closely evaluate the potential rerouting of flows at both the Landon Branch and Wooded Acres lift station sites. Staff has indicated that in a number of areas within the Brazos Basin they are unable to locate certain manholes and pipelines.



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- City Identified Area #1
- City Identified Area #2
- City Identified Area #3
- City Identified Areas #4 & #5
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Project 2-20: Asset Renewal Project Areas (Not Scoped)

G:\GIS\Projects\1-02231\Maps\No_Project Map.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

Area 5 – Portion of the Brazos Basin. **The existing 15-inch and 18-inch gravity sewer mains located between 11th Street and 12th Street from Ross Avenue to Dutton Avenue are known to be in poor structural condition and exhibit inadequate hydraulic capacity during wet weather events.** This area, similar to Area 4 above, has also been identified by the Team as part of the same capacity and hydraulic improvements project mentioned above. The existing line diameters vary widely in this area. The Team will closely evaluate the potential rerouting of flows at both the Landon Branch and Wooded Acres lift station sites. Staff has indicated that in a number of areas within the Brazos Basin they are unable to locate certain manholes and pipelines.

2.5 Summary / Prioritization of City Identified Lift Stations and Force Main Deficiencies

The 21 most significant lift stations within the system were identified and ranked based upon the impact to the City of Waco should the lift station experience a total operational failure.

As part of the Team's goal of capturing historical knowledge, meetings were held with City of Waco lift station staff to discuss their historical and institutional knowledge of the existing lift station and force main systems. City of Waco and Team staff identified the 21 most significant lift stations within the system. These stations were then ranked based upon the impact to the City of Waco should the lift station experience a total operational failure. **Table 2-10** (Column 1) provides the initial impact rating assigned by the WWMP team. Columns 3 and 4 provide the rankings assigned by the COW lift station staff. It should be noted that the rankings included within Table 2-10 are initial rankings and assessments and further analysis can be found within Chapter 6.

City of Waco staff also provided pump capacity and settings data for many of the system lift stations. The Team worked with City staff to obtain additional information that may be of use including: pump run times, performance testing, pressure readings, maintenance logs, pump curves, and record drawings. This data is included within Chapter 6 of the report.

Table 2-10: Lift Station Condition Rating and Capacity (Per City Staff)

Impact Rating	Lift Station Name	Condition Component[1]	Capacity Component[4]	Overall Condition / Capacity Rating	Original Construction Date[2]
VERY HIGH IMPACT	Landon Branch				Rehab 1988
	Bosque				Rehab 2005
	Church Road				2000
	Wooded Acres				1999
	Lindsey Hollow				1979
	Lake Shore				Pre 1970
HIGH IMPACT	Twin Rivers				2001
	Park Lake[3]				1961
	Village Green				1970
	Village Lake				1988
	Green Leaf[3]				1974
MEDIUM IMPACT	TSTC				1991
	Riverside				2006
	Hillcrest				1971
	Flat Rock				1992
LOW IMPACT	Inverness				Rehab 1996
	Ledge Stone				2008
	Avon				1996
	Buckingham				2003
	McLennan County Jail				2007

Very Good Condition
Good Condition
Fair Condition
Poor Condition
Very Poor Condition

(1) Per Utilities staff and/or field verification
(2) or Last Rehabilitation Date
(3) Consider Moving to Very High Impact per Utilities staff due to proximity to Lake Waco
(4) Reference Chapter 6 for actual capacity in gpm.

Table 2-11 summarizes coordination efforts with City staff regarding various system lift stations as well as the condition of their associated force mains.

Table 2-11: Lift Station Summary

Lift Station	Comments / Notes
Landon Branch	Fair rating for both capacity and condition. Overall the City does not have many problems with this station. Collection crews reworked the gravity line coming into the station and this seemed to help some of the issues that were occurring at the station. This is one of the City's largest stations. One concern is that the power is 240V (75 HP motors).
Bosque	Good rating for both condition and capacity. Station was completely rebuilt approximately 8 years ago. Staff generally has very few problems. Currently the only issues seen are small mechanical issues with seals, etc.
Church Road	Very poor rating for condition of lift station and of associated force main. Staff indicated that this station and force main should be at the top of the list for replacement. Staff conveyed that the existing 12-inch ductile iron force main was not poly-wrapped during construction. The combination of corrosion and high surge pressures in the line has contributed to many problems. Station has a very high head (~330 ft TDH).
Wooded Acres	Good rating for both condition and capacity. Station originally pumped to the Landon Branch lift station. In 1999 a new station and force main was constructed and flows were rerouted from Landon Branch lift station to Cottonwood/Twin Rivers basins (La Porte and Valley Mills intersection). The 1999 12-inch force main is in very poor condition. Crews have to make repairs on force main frequently. When crews make force main repairs on the 1999 line, the Wooded Acres lift station flows are temporarily routed (bypass pumped) through the original 10" force main to the Landon Branch lift station. Before the DAF Plant came online, the City had tremendous problems with the Wooded Acres pumps and would constantly have to replace pumps because of all the sediment and carbon coming from the filter backwash from the Mt. Carmel Water Treatment Plant (on the order of replacing one pump per month). Since the DAF Plant came online, large amounts of carbon are no longer needed in the treatment process, therefore improving the performance of the Wooded Acres pumps. The DAF Plant has a small pump station that pumps the skimmed algae into the collection system and to the Bosque Lift Station; no problems have been noticed to date.
Lindsey Hollow	Good rating for condition and capacity based upon its age. Historically, significant grease has been generated upstream of the station (assumed to be from the Methodist Home). The incoming gravity lines have stopped up frequently and are considered to be in very poor condition. Recently, the grease problem has eased up. City has recently bid a project that will replace several manholes within the Methodist Home area. This lift station will be evaluated for potential abandonment and to see whether or not it could be a gravity feed constructed by trenchless methods into the West Bank interceptor.
Lake Shore	Fair rating for condition and good rating for capacity. Historically, this station has had problems with bricks coming into the wet well from upstream brick manholes. This problem seems to have lessened in recent years. The inflow line coming into this station gets stopped up frequently and is in very poor condition. Station sees very few mechanical issues.
Twin Rivers	Good rating for condition and capacity. This station generally has a small number of problems.
Park Lake	Very poor condition and capacity rating. This station is located adjacent to Lake Waco and is in a low lying area that is susceptible to inflow when the lake level rises. Dry pit station built in early 1960's. New pumps and check valves were installed approximately 3 years ago. City would like station to be changed to a submersible station. City would also recommend moving station due to its proximity to the lake.

Lift Station	Comments / Notes
Village Green	Fair rating for condition and capacity. Have to use level floats on this station because a lot of soap and suds come into this station and cause false readings when using a level transducer. City has not had any problems with force main attached to Lake Shore Drive bridge.
Village Lake	Very poor rating for condition and capacity. Many upstream SSO's.
Green Leaf	Very poor rating for condition and capacity. Circa 1970 station is located adjacent to Lake Waco and is in a low lying area that is susceptible to inflow when the lake level rises. Dry pit goes under water when the lake is up. City would like station changed to a submersible station. City would also recommend moving station due to its proximity to the lake.
TSTC	Fair rating for condition and capacity. The main issue with this lift station is that the force main is in very poor condition. Station has three pumps and essentially pumps the same flow no matter if one, two, or three pumps are running. Waco / Bellmead / WMARSS are currently evaluating solutions to alleviate the problems with the station and have begun a feasibility study of the entire area. Force main coming from the TSTC station could eventually tie into WMARSS 3-10 year CIP Project #2. This would eliminate a large portion of the troublesome force main and reroute flows off of the Bellmead interceptor. Staff mentioned this would be very good because there would be no force main located along US 84 where all the businesses are currently located.
Riverside	Good rating for condition and capacity. This station generally has very little problems.
Hillcrest	Good rating for condition and capacity. Very little problems with this dry pit station. Staff thinks the original overflow bypass line (on record drawings) has been plugged.
Flat Rock	Fair rating for condition and capacity. City conveyed that this station has a huge wet well. Some of the upcoming new development along Flat Rock Road will drain to this station and staff has always wondered about rerouting the flows from this lift station all the way to China Spring Highway, so they would never go to the Village Lake lift station. Will be looked at as a possible candidate for abandonment.
Inverness	Fair rating for condition and capacity. Station was converted to submersible from dry pit in the 1990's. Some power/generator problems are present at the station possibly attributable to ground movement. The main issue with this station is the force main is in very poor condition. City attributes the force main problems to pressure problems. It has blown out on several occasions under the access driveway.
Ledge Stone	Very good rating for condition and fair rating for capacity. Staff says that they have had no major problems with this station being that it was only built in 2008, have only had some normal pump pulling and maintenance. Staff said that the electric bill for this station seems to indicate that a lot of pump cycling occurs at this station. Staff was curious how this would be affected as development continues around the station.
Avon	Good rating for condition and capacity. The main issue with this station is access (ingress and egress). Station is located down a narrow gravel road with many large oak trees with large limbs hanging over the road. Station has a tendency to occasionally lose power (would be preferable to add a generator on-site). The city is not able to get pump or vac trucks to the lift station site.
Buckingham	Fair rating for condition and capacity. Vortex impeller pumps and pressure gauges were installed in July of 2011 at this station. The pump company (KSB) thinks the actual head that the station is seeing may be greater than what the system curves and original design show.

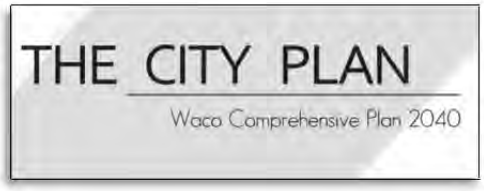
Lift Station	Comments / Notes
McLennan County Jail	Very poor rating for condition and capacity. The force main is too small and pumps are running almost constantly even in dry weather flow. Debris from jail. The 4" force main outfalls into a 12" gravity line that drains into the LaSalle Lift Station. For at least the last year Waco has had a temporary bypass pumping arrangement set up just upstream of the La Salle Lift Station because the 12" gravity line has collapsed (Oncor Pole installation nearby). Discussed the potential future abandonment of this station when WMARSS 3-10 Yr. CIP Project No. 1 complete (approximately 3 year timeline).
TX State Little League	City staff continues to have issues at this station, but things have improved. They have a lot of problems with floating debris coming into this station. It always appears to be items that would come from the Baylor Equestrian Center next door; however, City crews have walked this line multiple times and never discovered any problems. This lift station serves the ball fields in addition to anything along University Parks Drive and south towards Loop 340. Serves big apartment complex. Station has been inundated in the past when water crews flushed hydrants and discharged water into an adjacent manhole. This amount of flow would be too much for the station, but recent coordination with water staff has virtually solved this issue.
Syrian Club	Very poor rating for condition. The wet well is very small and with any loss of power the wet well fills up before anyone can make it to the site. Station is worrisome. Location is bad. The station is old and undersized. Much preferred if the station were relocated to other side of Old McGregor Road.
Arrowhead	Station causes constant problems for the City. Pumps have to be pulled on almost a weekly basis. Staff is trying to hold off on any pump rebuilds/rehab work since the station will be abandoned in the near future. Project to abandon this station is scheduled to be bid in Spring 2014.
Stone Creek	Station is similar in age to Arrowhead and staff is hoping to be able to rebuild Arrowhead pumps and then use them at Stone Creek Station once Arrowhead is offline.
Windmill Hill	Poor rating for condition. Station has big issues with power and the pumps/motors are obsolete. Staff assumes station has adequate pumping capacity.
Falcon Pointe	Good rating for condition. Capacity could start becoming an issue as this most recent development phase builds out, of which approximately half is gravity and approximately half flows to lift station. This station sees a fairly large amount of grease.
Braemer	Station only serves one house. It is not known why the City owns and maintains this station.
Deerwood	Station is old and worrisome.
Paul Quinn	City conveyed that if the gravity line is fixed behind the building then this station could be abandoned, because originally it was only installed as an emergency repair. Station to be evaluated to determine if it can be abandoned.
Bosqueville	Poor rating for condition and fair/poor rating for capacity. The pumps and motors in this dry pit station were replaced within the last year or two.
Tinkers Branch	Station serves one house. It is not known why the City owns and maintains this station.
China Spring	Good rating for condition.
South Fork	Completed in 2013. Very good rating for condition.

THIS PAGE IS INTENTIONALLY LEFT BLANK

CHAPTER 3 – SYSTEM PLANNING, POPULATION AND FLOW PROJECTIONS

3.1. Background

The City of Waco's last comprehensive *Wastewater Master Plan* was completed in 1975. Subsequent to this effort, three broad recommended wastewater projects were suggested as part of the City's *Comprehensive Plan 2000*. As of 2013, one of these broad recommendations has been completed, one was determined to not be in the City's best interest and one has yet to be addressed.



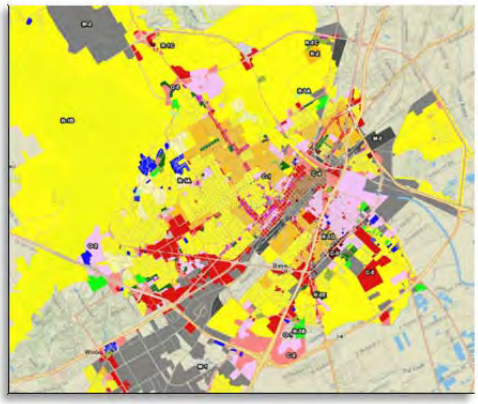
The current Collection System Master Planning effort will greatly assist City staff in understanding both the operation and hydraulic capacity of today's collection system as well as understanding the implications of upcoming expansion as additional development occurs in the future. The City has recently finalized the *Downtown Corridor Study* as well as updating *The City Plan (Waco Comprehensive Plan 2040)*. Growth projections that have been developed as part of these endeavors will be used to methodically plan for future growth in those areas designated for such growth.

A general consensus regarding Waco's future can be characterized as stable with modest growth potential based upon several key factors. These factors are identified as follows:

- Waco's geographic location in Central Texas, between the Dallas/Fort Worth Metroplex and Austin, and along IH-35, one of the primary U.S. arteries from Mexico to Canada.
- The success and growth of higher education – Baylor University, McLennan Community College, and Texas State Technical College.
- Excellent healthcare facilities – Baylor/Scott & White/Hillcrest and Providence Hospital.
- A reliable surface water supply, robust transportation facilities, solid waste facilities, and wastewater treatment and infrastructure facilities.
- A valued quality of life with a strong sports venue, water recreation with Lake Waco and the Brazos River, scenic countryside, and a low cost of living.

3.2. Land Use

With Waco being located along the IH-35 corridor, this provides for additional growth within both the City and ETJ as increased future development opportunities continue. The City should plan prudently in order to be prepared to accommodate this anticipated future growth.



City of Waco Zoning Map

The City's *Comprehensive Plan 2000* is currently used to guide development of all land within the City. This plan includes a Land Use Plan that takes existing land use, development trends, and policies into account as it guides zoning decisions and proposed land use patterns. The City grows by land subdivision and development, which beneficially influences economic conditions. Zoning is a means of ensuring that land uses are properly situated in relation to one another and provides space for each type of development. Thus, the planning process directs new growth into appropriate areas while controlling development density in each area so that property can be serviced adequately by municipal facilities such as the sanitary sewer system.

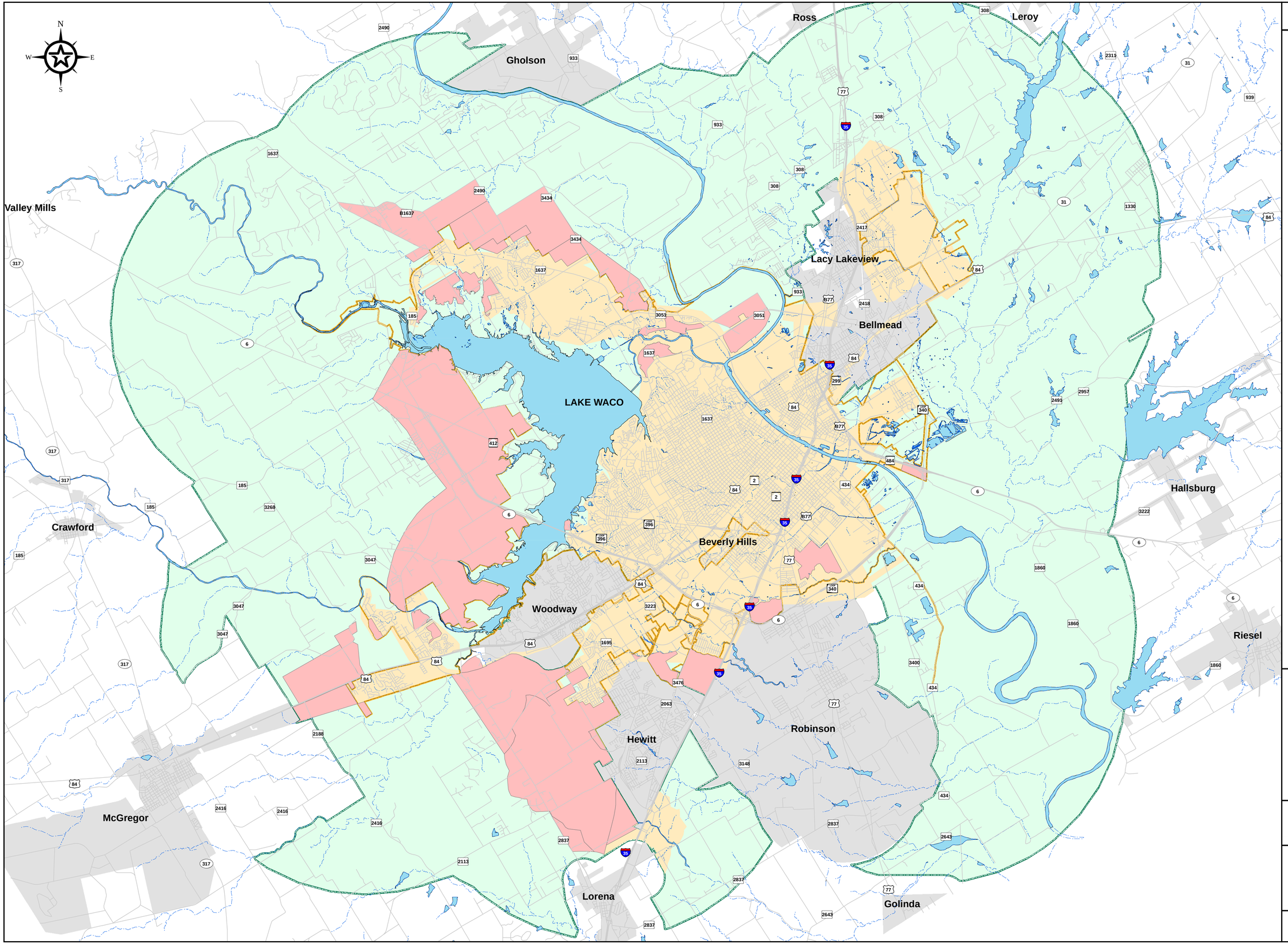
Data shows over 24,000 acres of land utilized for residential purposes in the City and over 20,000 acres that is utilized for public, semi-public, and commercial purposes. Mixed use (i.e. both residential and commercial) development is associated with an additional 3,600 acres of land. Over 7,500 acres of land is utilized by industrial entities. This land use data was not used to estimate wastewater flows for this study because detailed population data was available.

3.3. Service Areas

The existing wastewater service area for the City of Waco exceeds 42,000 acres and is shown in Figure 3-1. Service area boundaries were determined initially by examining the spatial extent of the City's existing water and sewer pipelines with Geographic Information System (GIS) software. These boundaries were refined after reviewing census block data so that areas that currently have few people present and areas that are not in the proximity of sewer infrastructure are not included in the existing service area. These adjacent locations that are not included in the service area are locations where septic systems are currently utilized or wastewater service is provided by an entity other than the City of Waco. The existing service area was confirmed through meeting with the City's planning staff.

3.3.1. Wastewater Service Envelope

The existing wastewater service area consists of the current city limits (with a few exceptions) and is considered the "Wastewater Service Envelope" for the City. Figure 3-1 shows the current service envelope as well as the projected 2040 service envelope. Wastewater service within the envelope is provided by public wastewater facilities owned and maintained by the City of Waco. Wastewater service for areas located outside the envelope (Waco ETJ area) is provided by on-site sewage facilities (septic systems). Over the next 25 years, properties currently served by septic systems should transition to public wastewater service as the service envelope expands. The future service area was determined by identifying potential developments adjacent to the existing service area that the City of Waco Planning department envisions being developed before 2040.



LEGEND

- Current Service Envelope
- 2040 Service Envelope
- Waco City Limits
- Waco ETJ Limit
- City Limits of Surrounding Municipalities
- Surface Water
- Stream

CITY OF WACO

0 3000 6000 12000

GRAPHIC SCALE (FEET)

Figure 3-1: Wastewater Service Envelope

G:\GIS\Projects\1-02231\Maps\Service Envelope Map.mxd

LEGEND

- New Development Area
- Redevelopment Area
- Maintenance Area
- Waco City Limits
- Waco ETJ
- City Limits of Surrounding Municipalities
- Surface Water
- Stream

CITY OF WACO

0 2500 5000 10000

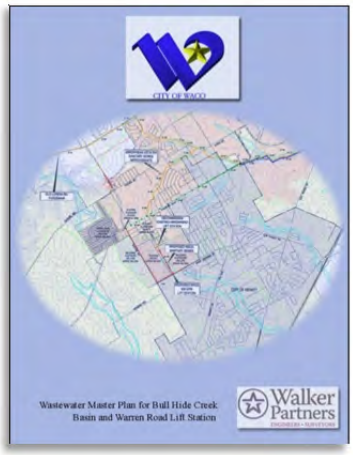
GRAPHIC SCALE (FEET)

Figure 3-2: Future Developement and Maintenance Areas

G:\GIS\Projects\1-02231\Maps\Future Development and Maintenance.mxd

3.3.2. Future Development and Maintenance Areas

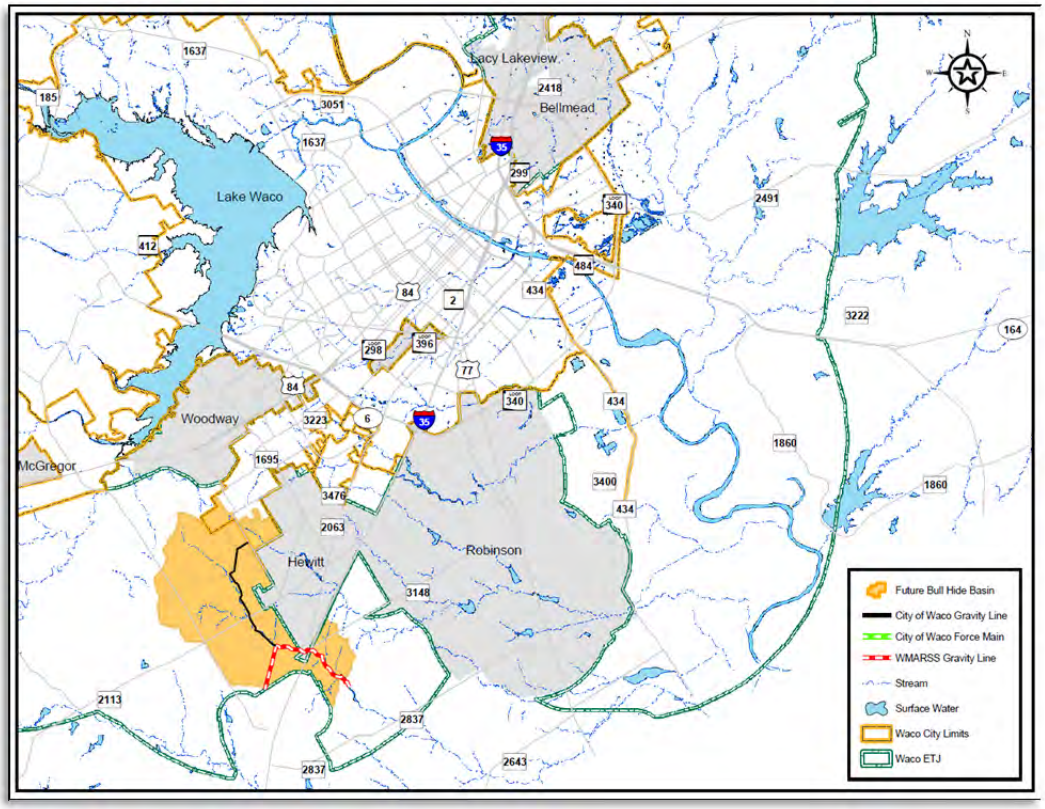
Figure 3-2 shows areas where new development is expected to occur as well as the areas that are considered maintenance areas. The maintenance area will require expenditure of capital on the existing wastewater system in the form of asset renewal projects in order to maintain an adequate level of service moving forward. Figure 3-2 also shows redevelopment areas in the downtown "core". The redevelopment area shown consists of the limits of the City of Waco Tax Increment Financing (TIF) Zones which are created for the purpose of facilitating revitalization and development throughout the downtown core of the City and along the Brazos River Corridor. TIF is a public financing method that is used as a subsidy for redevelopment, infrastructure, and other community improvement projects.



3.3.3. Bull Hide Basin

The Bull Hide Basin is a proposed new wastewater basin that will begin service in early 2015. Figure 3-3 below shows the limits of the new basin (orange area) which contains a newly constructed wastewater interceptor (21", 24" & 27") and a newly constructed wastewater lift station named the Warren Road lift station. This infrastructure forms the backbone of the Bull Hide Basin and will support growth past the planning period of this report; and will allow for future flow reroutes away from currently overloaded lines along Flat Creek near Mars Dr. These overloaded lines are known to City staff to experience SSO's during rain events.

Figure 3-3: Bull Hide Basin



3.4 Population Projections

Greater Downtown Waco has experienced slow, but steady growth in population over the last few decades. However, most of the population growth in McLennan County since the 1960 Census has taken place outside the city limits. City planners have observed growth in McLennan County that is focused outside of Loop 340. On the other hand, growth inside Loop 340 has not been as significant and in some areas, population decreases have been observed. The downtown core of Waco currently has a relatively young population and a greater share of rental housing.

Greater Downtown Waco remains a major employment center for the City with 40 percent of Waco's office space. However, most industrial and retail space is located outside of the downtown area. While Waco's economy has been driven historically by the manufacturing sector, new emerging industries include education; health care services and equipment; advanced manufacturing and aerospace; professional and financial services; and supply chain management. Commercial sectors that currently have strong projected annual growth include leisure and hospitality; construction; professional and business services; and education and health services.

3.4.1. Historical and Current Population

Total population estimates consist of both residential and commercial components. Current *residential* population estimates were developed from 2010 census block data and current *commercial* population estimates were developed from employment data from the Texas Workforce Commission. Population estimates were projected for each individual Traffic Analysis Zone (TAZ) within the service area. TAZ's are areas bounded by roadways that planners use to analyze data and plan for the future of the City by projecting various infrastructure needs. Residential population is defined as that population physically residing in single and multi-family residences located within a TAZ. Commercial population is defined as that population that travels into or stays within a TAZ for employment activities during a normal work day. See Appendix B for population by TAZ.

US Census Bureau data counts were obtained for the years 1960, 1970, 1980, 1990, 2000 and 2010. US Census Bureau estimates were utilized for 2011-2013. Yearly population data from 2001 through 2009 was unavailable; these values were interpolated from available data. The data presented in Table 3-1 shows historical residential population and indicates that Waco has experienced an average annual growth of approximately 0.98% over the last 13 years. Growth has been distributed differentially over the greater Waco area over these years.

Table 3-1: Historical Population

Year	Population	Average Annual Growth Rate
1960	97,808*	-
1970	95,326*	-
1980	101,261*	-
1990	103,590*	-
2000	113,726*	-
2001	114,788**	0.93%
2002	115,860**	0.93%
2003	116,942**	0.93%
2004	118,034**	0.93%
2005	119,137**	0.93%
2006	120,249**	0.93%
2007	121,372**	0.93%
2008	122,506**	0.93%
2009	123,650**	0.93%
2010	124,805*	0.93%
2011	126,569*	1.41%
2012	127,771*	0.95%
2013	129,030*	0.99%

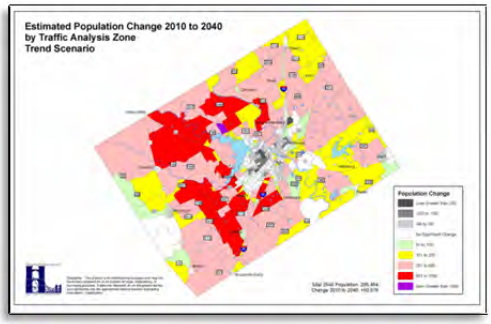
* US Census Bureau Count / Estimates
** Interpolated Data

3.4.2. Projected Population

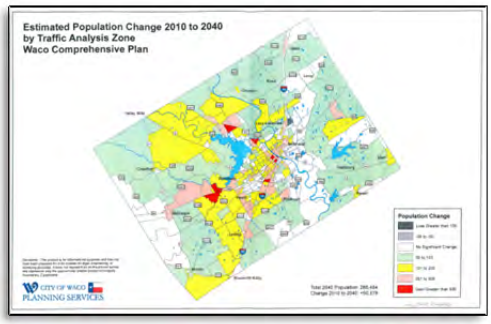
Population projections are an important component of the wastewater master planning process. The level and distribution of the growth dictates where future infrastructure improvements / upgrades will be required. It is often difficult for individual cities to accurately predict how fast or slow development will occur within their corporate limits.

For the purposes of the Wastewater Master Planning effort, three data sources have been analyzed regarding projecting population growth:

1. The Waco Metropolitan Planning Organization's (MPO) "Estimated Population Change by Traffic Analysis Zone (TAZ)," and based upon Projections of Population of Texas and Counties in Texas for 2010-2050, by the Texas State Data Center (2012).
2. The Texas Water Development Board's "2011 Regional Water Plan."
3. Census Data by the U.S. Census Bureau (2000-2010).



"Trend Scenario"



"Alternative Land-Use Scenario"

3.4.2.1 Waco MPO

The Waco MPO coordinates transportation planning activities for all of McLennan County. The Waco MPO's current population projections for McLennan County are based upon an average annual growth rate of 0.66% with two proposed growth pattern scenarios:

1. "Trend Scenario" (referred to as "S1" by the MPO) which is based upon urban sprawl to the "outskirts" of the City which has been the tendency for the past 30 years.

2. "Alternative Land-Use Scenario" (referred to as "S2" by the MPO) which is based upon a return of growth in the inner city, or core of Waco with only modest growth in the "outskirts."

In 2013 the local MPO Board selected the "Alternative Land Use Scenario" for transportation planning purposes through 2040 which is based upon an average annual growth rate of 0.66%.

3.4.2.2 Texas Water Development Board

The Texas Water Development Board's (TWDB) "2011 Regional Water Plan" contains population projections for 1) the entire state of Texas; 2) Region G (or Brazos G), which consists of the Brazos River Basin, of which Waco is in the heart of this region; and 3) McLennan County.

A summary of the Texas Water Development Board's population projections are shown below in Table 3-2:

Table 3-2: "2011 Regional Water Plan" Population Projections

County, Region, or State	2010 Population (Actual)	2040 Population (Projection)	Avg. Annual Growth Rate (%)
McLennan County	231,882	282,177	0.66%
Region G (Brazos G)	1,957,767	2,873,382	1.29%
State of Texas	25,388,403	37,734,422	1.33%

One can readily recognize that the TWDB's population projections for McLennan County (0.66%) are consistent with the MPO's "Estimated Population Change 2010 to 2040" (0.66%). Both sources of population projection data were from the Texas State Data Center for population projections for McLennan County.

An important aspect regarding the Texas State Data Center's projections is that the growth rates are only at the county level and not at the city level. The TWDB's Water for Texas 2012 State Water Plan states "the Texas Data Center projections are only done at county level, requiring further analysis to develop projections for the sub-county areas."

3.4.2.3 U.S. Census Bureau

The Census data published by the U.S. Census Bureau for the City of Waco for the years from 2000 to 2010 reveal that the average annual growth rate within Waco's city limits during that time period was 0.93%. Further, the Census Bureau published an average annual growth rate for McLennan County (2000-2010) of 0.96% - slightly higher than TWDB's predicted growth rate for McLennan County (0.66%), yet slightly lower than TWDB's predicted growth rate for Region G (1.29%). Therefore, for planning and engineering population projections for Waco and its extra-territorial jurisdiction, an annual growth rate ranging from 0.66% to 1.29% can be supported.

3.4.2.4 Population Distribution

With regard to how the growth rate will be distributed, planners and engineers may hold divergent viewpoints. Since the aftermath of the destruction of downtown Waco by the tornado of 1953, Waco has experienced urban sprawl. For almost 60 years now single-family development has occurred in the suburban areas around Waco and is generally characterized by separate, isolated pods of houses in subdivisions located adjacent to, or near, major traffic thoroughfares. The engineering challenges that exist with suburban sprawl include:

- Difficulty in supplying City of Waco water service at desired flow rates and pressures due to the extreme distance of the suburban subdivisions to Waco's water supply facility(ies). Likewise, this same condition creates operational and maintenance issues. Long, single pipeline feeds to a remote subdivision are not atypical, and these types of developments are vulnerable to service interruptions from water main breaks; water quality issues resulting from extensive detention times typical of long, dead-end mains; and inadequate pressures and flows during peak times (also characteristic of single-feed, non-looped water systems).

- Difficulty in providing wastewater service to the isolated residential subdivisions. Due to terrain variations as well as long distances to City of Waco gravity sanitary sewer service, many suburban developments have occurred without City of Waco sanitary sewer service. Each of the dwellings within these subdivisions utilize on-site sewage facilities (OSSF's), which present engineers and planners with two significant challenges:

1. Environmental Challenge: Most of these developments are within Lake Waco's watershed (Waco's drinking water supply) and water quality degradation resulting from malfunctioning or poorly maintained OSSF's is a threat to Waco's drinking water supply as well as a threat to the recreational value of Lake Waco.

2. Sustainability/Financial Challenge: Single-family developments utilizing OSSF's as the wastewater system are required by ordinances to have a minimum lot size of 0.5 acres. Therefore, suburban subdivisions utilizing OSSF's can be characterized as large lot subdivisions which translates into more linear feet of street and waterline per lot, which further contributes to excessive operational and maintenance costs with fewer tax paying residents to support the O&M costs.

Consequently, engineers and planners recognize that the quality of Lake Waco (the lifeline of Waco) must be protected and that low-density, suburban sprawl is not economically sustainable. On a national level, urban planners have united in a movement known as "New Urbanism" to minimize urban sprawl and instead develop (or redevelop) complete communities that are economically, socially, and environmentally sustainable. Recently, Galina Tachieva of Duany Plater-Zyberk and Co. (DPZ) wrote an entire book (Sprawl Repair Manual) dedicated to case studies of failures resulting from urban sprawl and planning methods to mitigate current sprawl and minimize the promulgation of further sprawl. Ms. Tachieva's goal of her Sprawl Repair Manual is to "provide guidance for transforming fragmented and inefficient development into complete communities that are livable and robust."

City planners desire to plan for city core redevelopment where population densities are greater and City services, including transportation systems and infrastructure, are readily available.

Similarly, the City planners are concerned with continued threat of suburban sprawl in the future and the potential inequity of persons living in Waco's city core paying for costly infrastructure improvements for developments in the suburbs. As a result, **City planners desire to plan for city core redevelopment where population densities are greater and City services, including transportation systems and infrastructure, are readily available.** The practice of incentivizing developers to develop land on the extremities of the urban core is contradictory to the modern day land planning principles and practices.

The infrastructure in the core of Waco is aged and in many areas severely deteriorated. The cost to rehabilitate and or replace this infrastructure is significant, and the City of Waco will be challenged in the future to rejuvenate these assets.

These ideals and goals of developing, or redeveloping, the core city areas where Waco has tremendous investments in streets, drainage, water, and wastewater infrastructure has great merit; However, there are two significant economic and social issues that are inherent to these goals that need to be addressed. First, **the infrastructure in the core of Waco is aged and in many areas severely deteriorated. The cost to rehabilitate and or replace this infrastructure is significant, and the City of Waco will be challenged in the future to rejuvenate these assets.**

Second, the allure for Waco's citizens (and prospective citizens) to locate to the City's fringes is very strong. The school districts, aesthetically pleasing lots, neighborhoods, and amenities found in new homes and neighborhoods in the fringe areas are very desirable for young families as well as empty nesters. City planning efforts to curtail, eliminate, or minimize this urban sprawl in the future is doubtful.

3.4.2.5 Combined Scenario

Population projections for the City of Waco and its ETJ, and the distribution of that growth in Waco's environs for engineering and planning purposes through 2040 should be approximately 1% - consistent with historical census data from 2000-2010 and consistent with the Texas Water Development Board's 2011 Regional Water Plan population projections for Region G, or the Brazos River Basin. It is also worth noting that the *2013 WMARSS Large Diameter Interceptor Improvements Report* utilized a 1% per year annual growth rate.

The population distribution for engineering planning purposes was recommended to City Staff to be a combination of the "Alternative Land Use Scenario" and the "Trend Scenario" whereby the highest population projection for each Traffic Analysis Zone (TAZ) is utilized in a new scenario referred to as the "Combined Scenario." This "Combined Scenario" projects an average annual growth rate of 1.07% and is shown in Figure 3-4. The 2000-2010 U.S. Census Bureau's published average annual growth rates for Waco and McLennan County was 0.93% and 0.96%, respectively. See Appendix B for population by TAZ.

THIS PAGE IS INTENTIONALLY LEFT BLANK

N
W
E
S

Lake Waco

LEGEND

POPULATION CHANGE

- Loss Greater than 100
- -99 to -50
- No Significant Change
- 50 to 100
- 101 to 200
- 201 to 500
- Gain Greater than 500

Total 2040 Population: 322,820
Population Change from 2010 to 2040 by Traffic Analysis Zone: +88,423
2010 to 2040 Avg. Annual Growth: 1.07%

- Surface Water
- Waco City Limits
- Waco ETJ
- McLennan County Limits

CITY OF WACO

0 3000 6000 12000
GRAPHIC SCALE (FEET)

Figure 3-4: City of Waco Combined Population Projection Scenario

G:\GIS\Projects\1-02231\Maps\WP_Trending Population Change.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

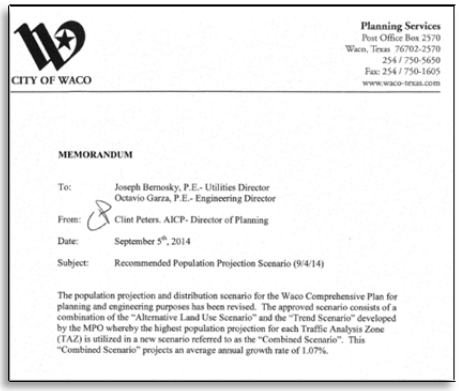
A comparison of the population projections evaluated in this section to the "Combined Scenario" projection recommended herein is shown below in Table 3-3:

Table 3-3: Comparison of Population Projections

Scenario	2010 Population (Actual)	2040 Population (Projection)	Avg. Annual Growth Rate (%)
City of Waco TAZ Trend Scenario for McLennan Co. (S1)*	234,397	285,484	0.66%
City of Waco TAZ Alternative Land-Use Scenario for McLennan Co. (S2)*	234,397	285,484	0.66%
City of Waco Combined Population Projections for McLennan Co. (S1 & S2)**	234,397	322,820	1.07%
TWDB McLennan Co. ***	231,882	282,177	0.66%
TWDB Region G***	1,957,767	2,873,382	1.29%
TWDB State of Texas ***	25,388,403	37,734,422	1.33%

*TAZ = Traffic Analysis Zone used by the Metropolitan Planning Organization for transportation planning purposes.
**This scenario uses the higher of either S1 or S2 values for each TAZ.
***Texas Water Development Board's "2011 Regional Water Plan."

The Wastewater Master Plan Team believes that the "Combined Scenario" will allow City planners and engineers the foresight to create a strategic plan for a robust future for the City of Waco that through proper planning will promote methodical suburban development and compliment growth trends that re-energize the inner city and create sustainable, economically feasible, complete communities.



CITY OF WACO

Planning Services
Post Office Box 2570
Waco, Texas 76702-2570
254 / 750-5650
Fax: 254 / 750-1605
www.waco-texas.com

MEMORANDUM

To: Joseph Bernosky, P.E.- Utilities Director
Octavio Garza, P.E.- Engineering Director

From: Clint Peters. AICP- Director of Planning

Date: September 5th, 2014

Subject: Recommended Population Projection Scenario (9/4/14)

The population projection and distribution scenario for the Waco Comprehensive Plan for planning and engineering purposes has been revised. The approved scenario consists of a combination of the "Alternative Land Use Scenario" and the "Trend Scenario" developed by the MPO whereby the highest population projection for each Traffic Analysis Zone (TAZ) is utilized in a new scenario referred to as the "Combined Scenario". This "Combined Scenario" projects an average annual growth rate of 1.07%.

City of Waco Population Projection Memorandum

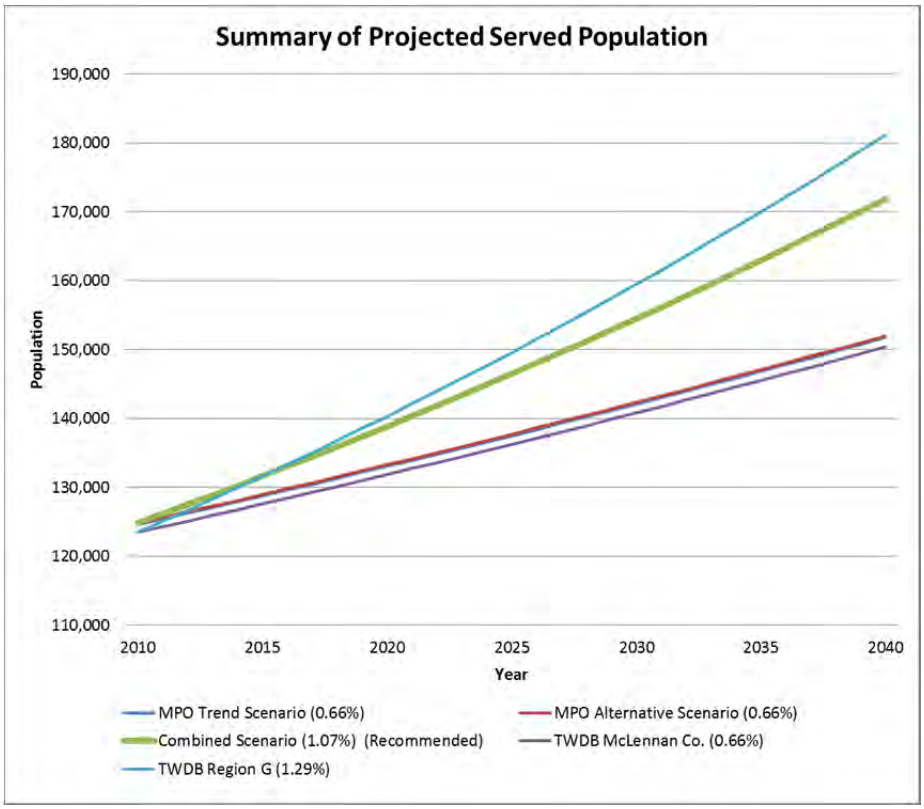
The Wastewater Master Plan Team received direction on September 5th, 2014 in a Memorandum from the City of Waco Director of Planning instructing the Team to proceed with the "Combined Scenario" which projects an average annual growth rate of 1.07%.

City of Waco population projections were developed for specific years (2015, 2020, 2030, 2040) based on the "Combined Scenario". Table 3-4 presents the projected population for each planning period.

Table 3-4: Projected Population

Year	Population	Average Annual Growth Rate
2015	131,644	1.07%
2020	138,857	1.07%
2030	154,491	1.07%
2040	171,886	1.07%

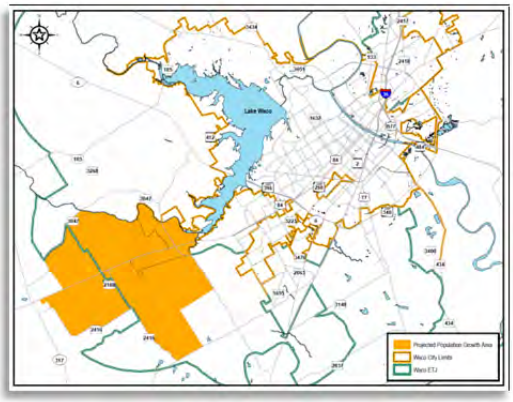
Figure 3-5: Summary of Projected Served Population



3.4.3. Additional Evaluation Areas

In addition to the overall population analysis for the entire City, populations were analyzed in more detail for several strategic / high-growth areas and are discussed below.

3.4.3.1 Speegleville Basin (West US 84)



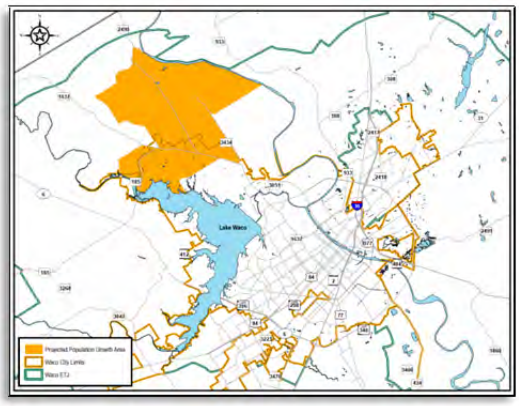
Highway 84 Growth Corridor

The "Combined Scenario" contains an average annual growth rate along the western Highway 84 growth corridor of 2.17%, which is consistent with historical growth trends in that corridor. Table 3-5, below, depicts projected growth, by TAZ, along the Highway 84 corridor.

Table 3-5: Highway 84 Corridor Growth Projections by TAZ

TAZ #	S1 2010-2040 Avg. Annual Growth Rate	S2 2010-2040 Avg. Annual Growth Rate	S1 & S2 "Combined Scenario" 2010-2040 Avg. Annual Growth Rate
243	4.41%	1.97%	**4.41%**
247	3.50%	0.91%	**3.50%**
248	2.46%	0.73%	**2.46%**
284	3.84%	0.95%	**3.84%**
382	0.65%	0.65%	**0.65%**
411	1.89%	1.01%	**1.89%**
412	1.03%	1.41%	**1.41%**
413	1.20%	1.53%	**1.53%**
Avg.	2.04%	1.23%	**2.17%**

3.4.3.2 Village Lake / Carver (China Spring)



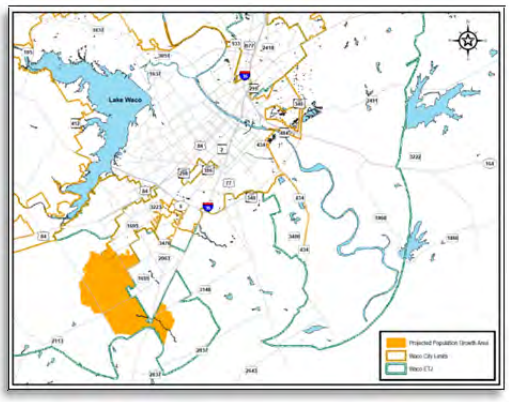
China Spring Area

The "Combined Scenario" contains an average annual growth rate of 2.16% for the China Spring area, which is consistent with the historical growth trends in that corridor. Table 3-6, below, depicts projected growth, by TAZ, in the China Spring growth area.

Table 3-6: China Spring Corridor Growth Projections by TAZ

TAZ #	S1 2010-2040 Avg. Annual Growth Rate	S2 2010-2040 Avg. Annual Growth Rate	S1 & S2 "Combined Scenario" 2010-2040 Avg. Annual Growth Rate
235	2.14%	1.28%	**2.14%**
237	0.94%	0.94%	**0.94%**
238	3.52%	2.34%	**3.52%**
239	3.98%	1.97%	**3.98%**
240	3.15%	1.20%	**3.15%**
241	6.70%	3.10%	**6.70%**
242	4.29%	1.37%	**4.29%**
305	2.05%	0.51%	**2.05%**
307	1.29%	0.31%	**1.29%**
320	5.05%	3.02%	**5.05%**
Avg.	2.16%	1.07%	**2.16%**

3.4.3.3 Bull Hide Basin



Bull Hide Basin

The new Bull Hide Basin is expected to experience population growth over the planning period partly as a result of the addition of the wastewater infrastructure. The "Combined Scenario" contains an average annual growth rate of 2.17% for the Bull Hide basin. Table 3-7 below, depicts projected growth by TAZ, in the Bull Hide basin.

Table 3-7: Bull Hide Basin Growth Projections by TAZ

TAZ #	S1 2010-2040 Avg. Annual Growth Rate	S2 2010-2040 Avg. Annual Growth Rate	S1 & S2 "Combined Scenario" 2010-2040 Avg. Annual Growth Rate
226	4.47%	1.02%	**4.47%**
250	3.62%	1.47%	**3.62%**
265	1.34%	0.47%	**1.34%**
416	1.77%	0.43%	**1.77%**
417	2.13%	0.62%	**2.13%**
Avg.	2.17%	0.60%	**2.17%**

3.4.3.4 City of McGregor

The City of McGregor currently contributes wastewater flow to the City of Waco wastewater collection system at the McGregor Executive Airport; however, future growth within the eastern limits of the City of McGregor will eventually generate additional wastewater flow that will also flow into the Waco wastewater collection system. Wastewater flows generated on the eastern portion of the City of McGregor will be discussed further in Section 3.5.4.

Available Census data indicates the City of McGregor had the following historical populations:

- 2000 = 4,727
- 2008 = 4,891
- 2010 = 4,987

The City of McGregor has utilized a 1.1% Average Annual Growth Rate on previous wastewater master plan studies which results in the following projected populations:

- 2015 = 5,267
- 2020 = 5,564
- 2030 = 6,207
- 2040 = 6,924

3.4.4 Populations of Major Wastewater Basins

Based on the preceding discussion, population is projected to increase in the City of Waco for the planning period. Tables 3-8 & 3-9 summarize the projected residential & commercial population for each major wastewater basin for 2010, 2015, 2020, 2030, & 2040. Figures 3-6 & 3-7 show the same information as Tables 3-8 & 3-9, but graphically in relation to the location of each major wastewater basin.

Table 3-8: Summary of Projected Served Residential Population by Major Wastewater Basin

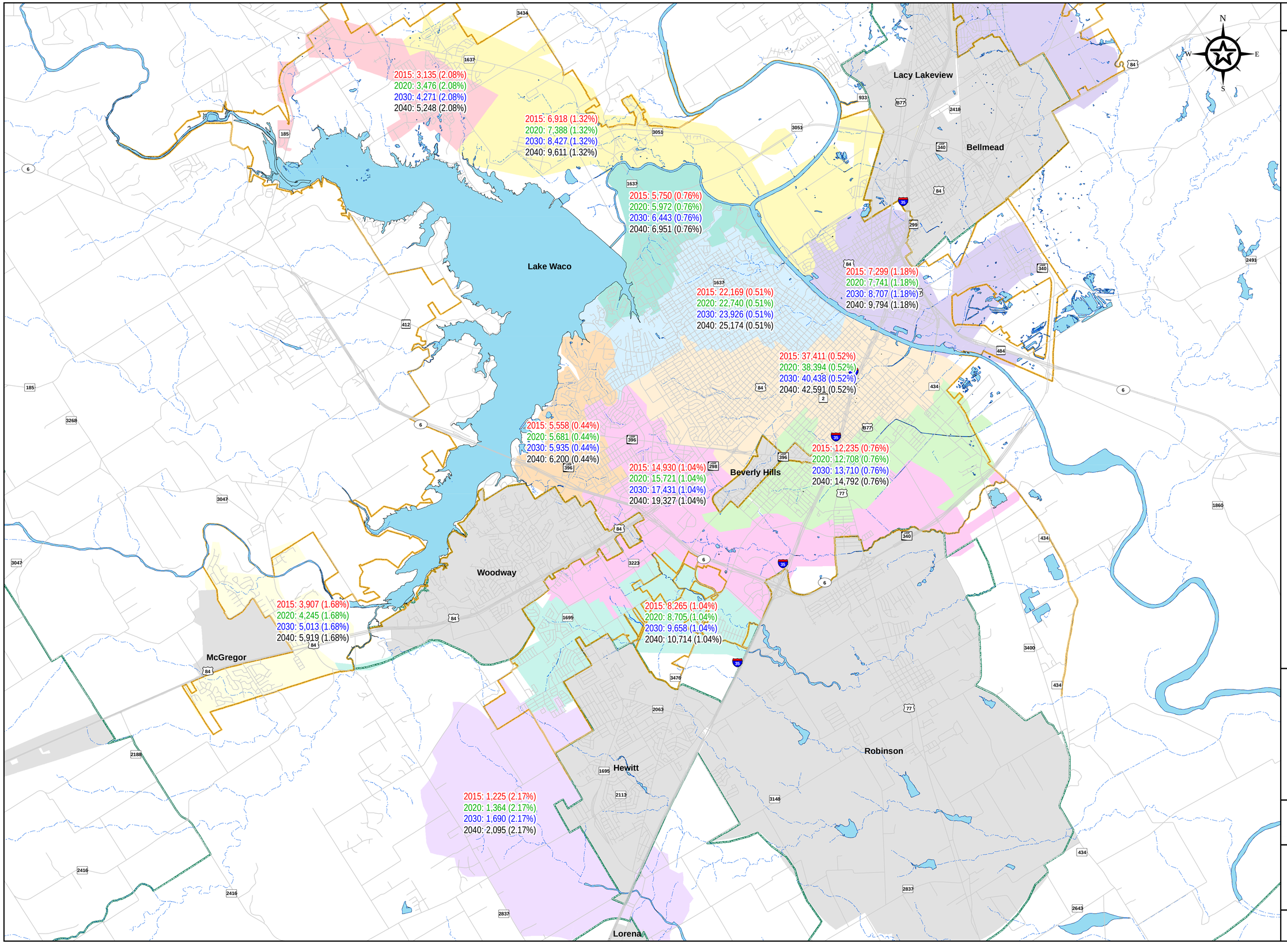
Major Wastewater Basin	2010	2015	2020	2030	2040
Barron's Branch	21,613	22,169	22,740	23,926	25,174
Bosque River	5,536	5,750	5,972	6,443	6,951
Brazos	36,453	37,411	38,394	40,438	42,591
Bull Hide**	-	1,225	1,364	1,690	2,095
Carver	6,478	6,918	7,388	8,427	9,611
Cottonwood	14,178	14,930	15,721	17,431	19,327
Flat Creek	7,847	8,265	8,705	9,658	10,714
MLK	6,883	7,299	7,741	8,707	9,794
Primrose	11,779	12,235	12,708	13,710	14,792
Speegleville	3,595	3,907	4,245	5,013	5,919
Twin Bridges	5,437	5,558	5,681	5,935	6,200
Village Lake	2,828	3,135	3,476	4,271	5,248
Total	**122,627**	**128,801**	**134,135**	**145,649**	**158,416**

**Bull Hide Basin values were projected using the "Combined Scenario" growth rate of 2.17%.

Table 3-9: Summary of Projected Served Commercial Population by Major Wastewater Basin

Major Wastewater Basin	2010	2015	2020	2030	2040
Barron's Branch	6,721	6,986	7,261	7,845	8,475
Bosque River	2,243	2,342	2,446	2,667	2,909
Brazos	17,145	17,641	18,151	19,215	20,342
Bull Hide	-	-	-	-	-
Carver	2,054	2,197	2,350	2,688	3,076
Cottonwood	27,016	27,708	28,417	29,891	31,441
Flat Creek	5,963	6,173	6,390	6,847	7,337
MLK	1,731	1,948	2,194	2,780	3,523
Primrose	4,096	4,303	4,520	4,987	5,503
Speegleville	352	374	398	450	509
Twin Bridges	2,998	3,060	3,123	3,253	3,389
Village Lake	291	320	351	423	510
Total	**70,610**	**73,052**	**75,601**	**81,046**	**87,014**

THIS PAGE IS INTENTIONALLY LEFT BLANK



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Bull Hide
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake

2015: Pop. (Avg. Annual Growth Rate)
2020: Pop. (Avg. Annual Growth Rate)
2030: Pop. (Avg. Annual Growth Rate)
2040: Pop. (Avg. Annual Growth Rate)

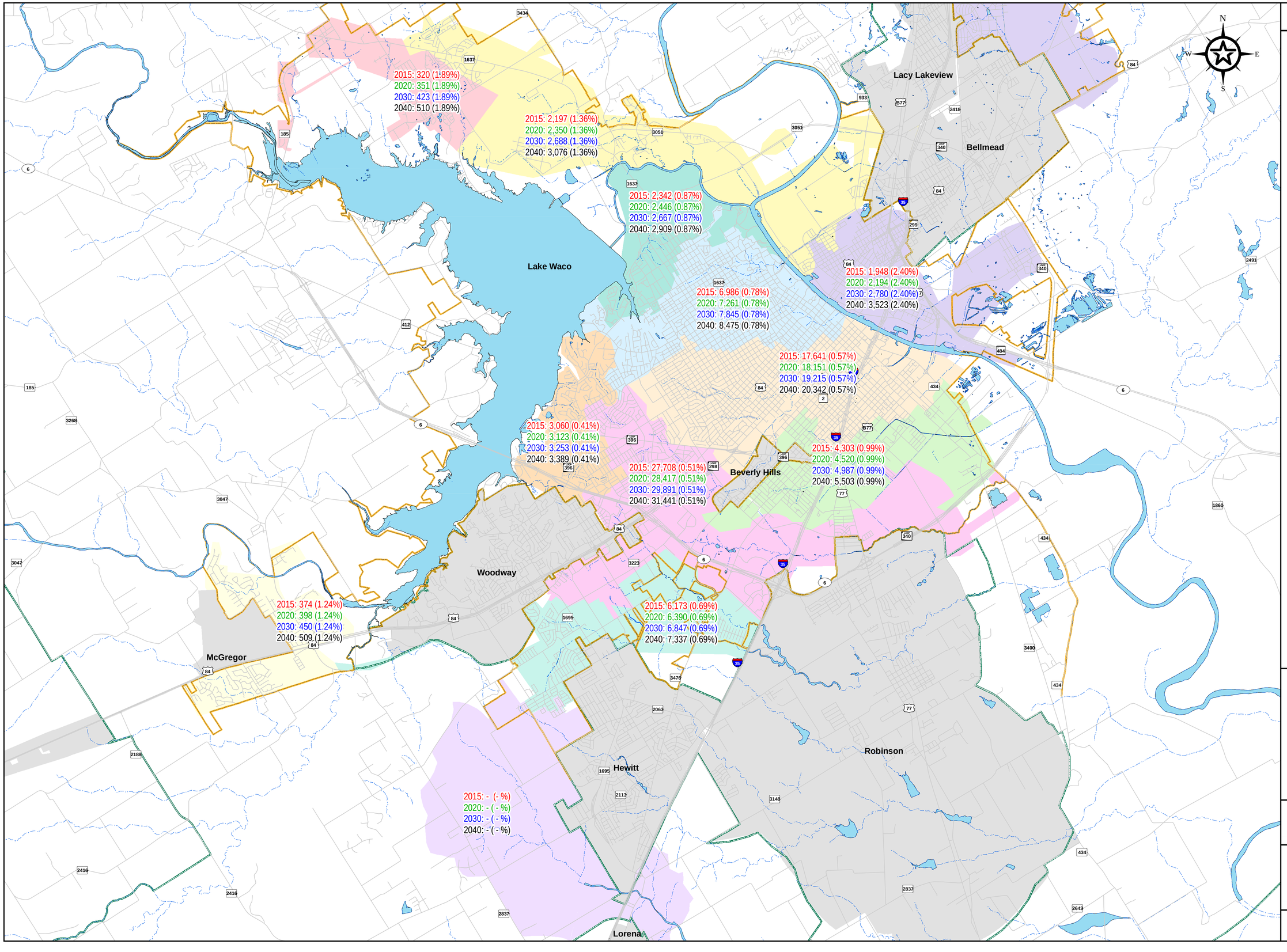
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 2000 4000 8000
GRAPHIC SCALE (FEET)

Figure 3-6: Residential Populations of Major Wastewater Basins

G:\GIS\Projects\1-02231\Maps\Pop and Flow Projection Map.mxd



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Bull Hide
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake

2015: Pop. (Avg. Annual Growth Rate)
2020: Pop. (Avg. Annual Growth Rate)
2030: Pop. (Avg. Annual Growth Rate)
2040: Pop. (Avg. Annual Growth Rate)

- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 2000 4000 8000
GRAPHIC SCALE (FEET)

Figure 3-7: Commercial Populations of Major Wastewater Basins

G:\GIS\Projects\1-02231\Maps\Pop and Flow Projection Map.mxd

3.5 Wastewater Flow Projections

3.5.1. Definitions

Wastewater flows are produced from residential (domestic), industrial, and commercial uses of water. Domestic wastewater originates primarily from kitchen, bathroom, and laundry sources, including waste from food preparation, dishwashing, garbage grinding, toilets, baths, showers, and sinks of a residential dwelling. In an average sewer system, about 65 to 85 percent of the potable water use is returned to a wastewater treatment facility or an on-site septic system. This return rate varies seasonally because the majority of water use that is not ultimately returned to a wastewater treatment plant is typically associated with consumptive water use such as irrigation.

Annual Average Flow – The arithmetic average of all daily flow determinations taken with a period of 12 consecutive months.

Average Dry Weather Flow - The arithmetic average of all daily flow determinations based on winter average water meter data.

Peak Wet Weather Flow – The highest flow that is projected to occur as a result of a 5-year 6-hour storm event.

Title 30, Part 1, Texas Administrative Code Chapter 217.32(a)(3) Table 1 gives a typical value for daily wastewater flow (for new facilities) in gallons per capita per day (gpcd). This information is summarized below:

- Residential = 100 gpcd
- Industrial = 20 gpcd
- Commercial = 20 gpcd

3.5.2. Historical and Existing Wastewater Flows

Water use data from January to March 2013 was utilized to estimate dry-weather wastewater flows.

While individual users of the City's water system are metered, individual wastewater system flows are not, and alternative means of determining current and future wastewater flows are necessary. During winter months, outside irrigation and other consumptive uses are minimal and most potable water used is returned to the wastewater collection system. This allows water meter billing data to be utilized as a surrogate for dry-weather wastewater flows. Water use from January to March includes very little outside irrigation (the majority of consumptive use) and display the lowest historical water use in Waco. **Water use data from January to March 2013 was utilized to estimate dry-weather wastewater flows.**

Water meter billing data from January to March 2013 was split into commercial and residential portions and aggregated by TAZ. The resulting flows were utilized as a representative estimate of the current "dry weather" wastewater flow for each TAZ. Current residential wastewater flow for each TAZ was divided by the current TAZ residential population to determine per-capita residential wastewater flow rates for each TAZ in the City's service area. The residential wastewater flow consists of both single family and multi-family residential buildings.

Similarly, current commercial wastewater flow for each TAZ was divided by the current commercial population to determine per-capita commercial wastewater flow rates for each TAZ in the City's service area. The overall system average rate of wastewater production for residential customers was determined to be about 72 gpcd. Alternatively, the overall system average rate of wastewater production for commercial customers was determined to be about 95 gpcd. In recent years, the wastewater industry has experienced a decrease in per capita wastewater flows (and higher strength waste stream) that can be attributed to water conservation efforts through installation of high-efficiency plumbing fixtures (low-flow toilets, low-flow shower heads, etc.).

Actual wastewater flows were measured by 24 temporary flow meters installed throughout the system and were used to calibrate the per-capita wastewater flow values for these "meter basins." This calibration process is described in Chapter 5. The calibrated wastewater flows are compared with initial wastewater flows estimated from winter average water use data and discussed in Chapter 5.

Wastewater flows from a number of industrial facilities are actually metered, and these flows can be used directly instead of using winter water meter data to estimate wastewater flows. The twenty largest industrial facilities were identified and their 2013 wastewater flow was utilized instead of the winter water billing data. The data presented in Table 3-10 was provided by City of Waco Utilities staff.

Table 3-10: Large Wastewater Customers

Company Name	1,000 gallons/month
Cargill Meat Solutions Corporation	24,686
Coca Cola	21,995
Pilgrim's Pride	19,083
Mars	11,044
Hillcrest Baptist Medical Center	6,074
Allergan, Inc.	4,961
VA Medical Center	4,414
Providence Health Center	4,213
Owens-Illinois	3,547
Alcoa Fastening Systems	3,242
Oak Farms Dairy	3,181
H&B Packing Company, Inc.	1,988
Packaging Corporation of America	1,485
L-3 Communication (Alodine)	1,270
Central Tx Corrugated	958
Precise Hard Chrome (Joy Drive)	696
Marathon	534
Precision National Plating Services, Inc.	447
Packless Industries	427
Caterpillar Work Tools, Inc.	262
Time Manufacturing Company	179
Hobbs Bonded Fibers	142
Tymco Inc.	93
Precise Hard Chrome (Plant)	91
Waco Metal Finishing	76
Mercury Tool	23
L-3 Communication (Batch)	18

City of Waco wastewater flows are treated by two WMARSS wastewater treatment plants. Review of WMARSS historical monthly wastewater permanent flow meter data reveals that Waco makes up roughly 82% of the total WMARSS flows. The annual average wastewater flow rates for each WWTP are listed in Table 3-11.

Table 3-11: Historical Annual Average Wastewater Flows

Year	Central WWTP (MGD)		Bull Hide Creek WWTP (MGD)		Total (MGD)	
	Waco**	WMARSS*	Waco	WMARSS*	Waco**	WMARSS*
2000	19.66	23.98	-	-	19.66	23.98
2001	22.06	26.90	-	-	22.06	26.90
2002	21.27	25.94	-	-	21.27	25.94
2003	19.63	23.94	-	-	19.63	23.94
2004	24.30	29.63	-	-	24.30	29.63
2005	20.24	24.68	-	-	20.24	24.68
2006	18.28	22.29	-	-	18.28	22.29
2007	22.25	27.14	-	-	22.25	27.14
2008	18.79	22.92	-	-	18.79	22.92
2009	21.13	25.77	-	-	21.13	25.77
2010	21.43	26.13	-	-	21.43	26.13
2011	18.22	22.22	-	-	18.22	22.22
2012	20.39	24.32	-	0.54	20.39	24.86
2013	18.34	21.64	-	0.73	18.34	22.37
2014	18.05	21.33	-	0.68	18.05	22.01

*Flow data provided by WMARSS staff.
**Flow data based on WMARSS fiscal year billing information provided by WMARSS staff.

3.5.3. Projected Wastewater Flows

Wastewater Flow projections were developed for specific years (2015, 2020, 2030, 2040). Table 3-12 presents the projected wastewater flows for each planning period.

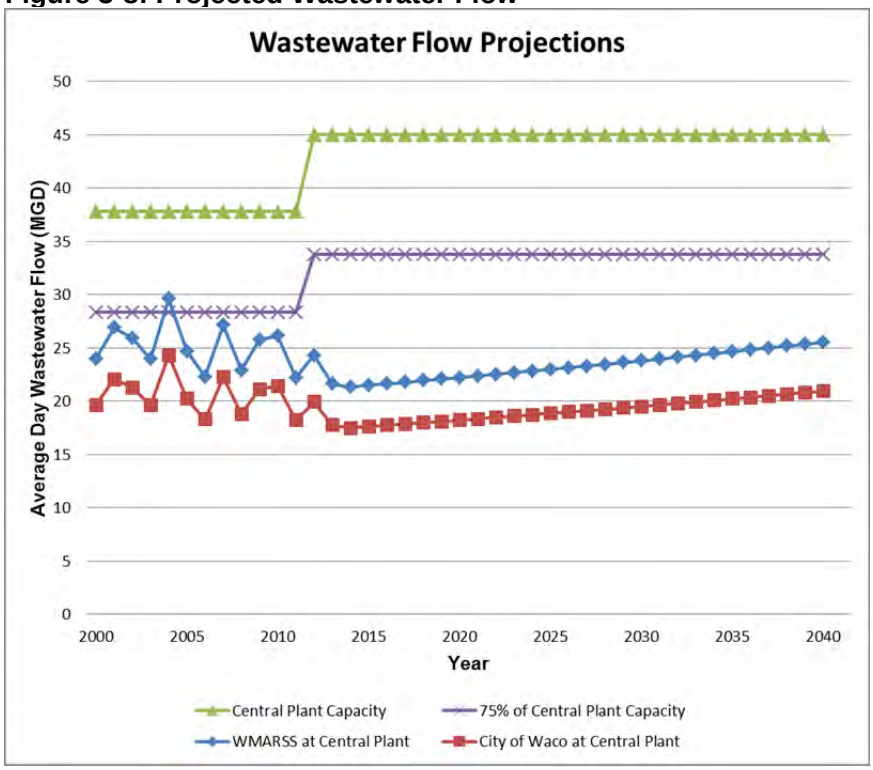
Table 3-12: Projected Wastewater Flows

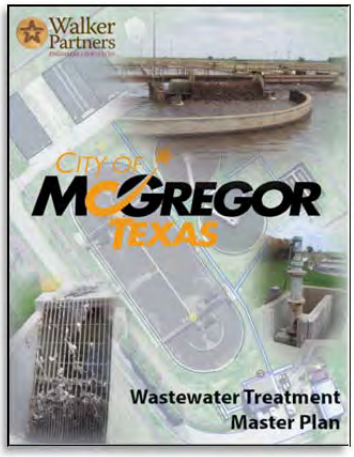
Year	City of Waco Avg. Day Flow (MGD)*	Peak Wet Weather Factor**	City of Waco Peak Wet Weather Flow (MGD)
2015	17.63	6.7	118.6
2020	18.22	6.7	122.5
2030	19.50	6.7	131.1
2040	20.94	6.7	140.7

*Flow based on winter average water meter data.
**Number shown is an overall system average based on a 5-year 6-hour rain event. Reference *Chapter 4 – Temporary Flow Monitoring* for explanation and determination of peaking factors.

The WMARSS Central WWTP was historically rated at an annual average flow capacity of 37.8 MGD from 1983-2010. A Plant expansion was completed in 2010/2011 that increased the permitted capacity to 45 MGD. The Bull Hide Creek WWTP has a rated annual average flow capacity of 1.5 MGD.

Figure 3-8: Projected Wastewater Flow





3.5.4. City of McGregor

As discussed in Section 3.4.3.4, the City of McGregor generates wastewater flows that (both now and in the future) are conveyed by the City of Waco wastewater collection system. The flows going to Waco comprise only a portion of the total McGregor flows. McGregor has its own wastewater treatment plant located on the south side of town that receives and treats wastewater. Walker Partners performed a Wastewater Treatment Master Plan for the City of McGregor in 2010 which evaluated several options for treating wastewater flows generated within the City. The following statistics are from that report:

- 1,780 Total Wastewater Connections
- 2.75 persons per connection
- 0.54 MGD Average Dry Weather Flow

Approximately half of the wastewater flow generated in McGregor is collected at the North Lift Station and pumped to the McGregor WWTP. One long-term option evaluated within the report was routing flows from the North Lift Station (989 connections) through a gravity interceptor along Harris Creek towards the City of Waco. It is unknown at this time how serious the City of McGregor may become about this option in the future. Discussions have been had regarding McGregor potentially becoming a member of WMARSS or, more than likely, becoming a wholesale wastewater customer of the City of Waco.

The City of Waco is currently in the design phase of the Sanitary Sewer Extension to Smith Road project which will provide wastewater service (via a 12”-18” Interceptor) for City of Waco ETJ area east of Cottonbelt Parkway and City of McGregor area west of Cottonbelt Parkway. The project will have joint funding between both Waco and McGregor. The project design calculations project a City of McGregor service area (at ultimate build out) of 470 acres consisting of 749 connections and the following flows:

- Average Dry Weather Flow = 91 gpm
- Peak Wet Weather Flow = 470 gpm

3.5.5. Flows Associated with Major Wastewater Basins

While historic projections are good for projecting growth on a City-wide basis, it is not prudent to assume that all of the currently undeveloped land within the ETJ will be fully developed by the year 2040. Growth will likely be concentrated in specific basins. Tables 3-13 through 3-16 provide projected wastewater flows by major wastewater basins (based on projected population multiplied by established per capita usage) for the years 2015, 2020, 2030 and 2040. Figure 3-9 shows the same information as Tables 3-13 through 3-16, but graphically in relation to the location of each major wastewater basin. Ultimately the wastewater flows should serve as the triggers for moving forward with identified capacity improvements. See Appendix B for flow by TAZ.

Table 3-13: Summary of Projected Wastewater Flows by Major Wastewater Basin (2015)

Major Wastewater Basin	Avg. Day Flow Rates (gpcd)*	Avg. Dry Weather Flow (MGD)	Wet Weather Peaking Factor***	Peak Wet Weather Flow (MGD)
Barron's Branch	65	1.763	10	17.628
Bosque River	75	0.512	5	2.558
Brazos	55	3.026	8	24.211
Bull Hide**	-	0.081	4	0.324
Carver	70	2.451	5	12.256
Cottonwood	80	3.807	7	26.649
Flat Creek	75	2.333	4	9.333
MLK	70	1.005	9	9.049
Primrose	60	1.034	8	8.269
Speegleville	135	0.588	4	2.352
Twin Bridges	110	0.771	6	4.625
Village Lake	75	0.260	5	1.298
Total		**17.63**	**-**	**118.6**

*gpcd values are based on three month winter average residential water meter billing data.
**Bull Hide Basin values were projected using the "Combined Scenario" growth rate of 2.17%.
*** Number shown is the major wastewater basin average based on a 5-year 6-hour rain event. Reference *Chapter 4 – Temporary Flow Monitoring* for explanation and determination of peaking factors.

Table 3-14: Summary of Projected Wastewater Flows by Major Wastewater Basin (2020)

Major Wastewater Basin	Avg. Day Flow Rates (gpcd)*	Avg. Dry Weather Flow (MGD)	Wet Weather Peaking Factor***	Peak Wet Weather Flow (MGD)
Barron's Branch	65	1.813	10	18.130
Bosque River	75	0.532	5	2.660
Brazos	55	3.108	8	24.864
Bull Hide**	-	0.090	4	0.360
Carver	70	2.518	5	12.590
Cottonwood	80	3.916	7	27.412
Flat Creek	75	2.380	4	9.520
MLK	70	1.072	9	9.648
Primrose	60	1.078	8	8.624
Speegleville	135	0.638	4	2.552
Twin Bridges	110	0.788	6	4.728
Village Lake	75	0.287	5	1.435
Total		**18.22**	-	**122.5**

*gpcd values are based on three month winter average residential water meter billing data.
**Bull Hide Basin values were projected using the "Combined Scenario" growth rate of 2.17%.
*** Number shown is the major wastewater basin average based on a 5-year 6-hour rain event. Reference *Chapter 4 – Temporary Flow Monitoring* for explanation and determination of peaking factors.

Table 3-15: Summary of Projected Wastewater Flows by Major Wastewater Basin (2030)

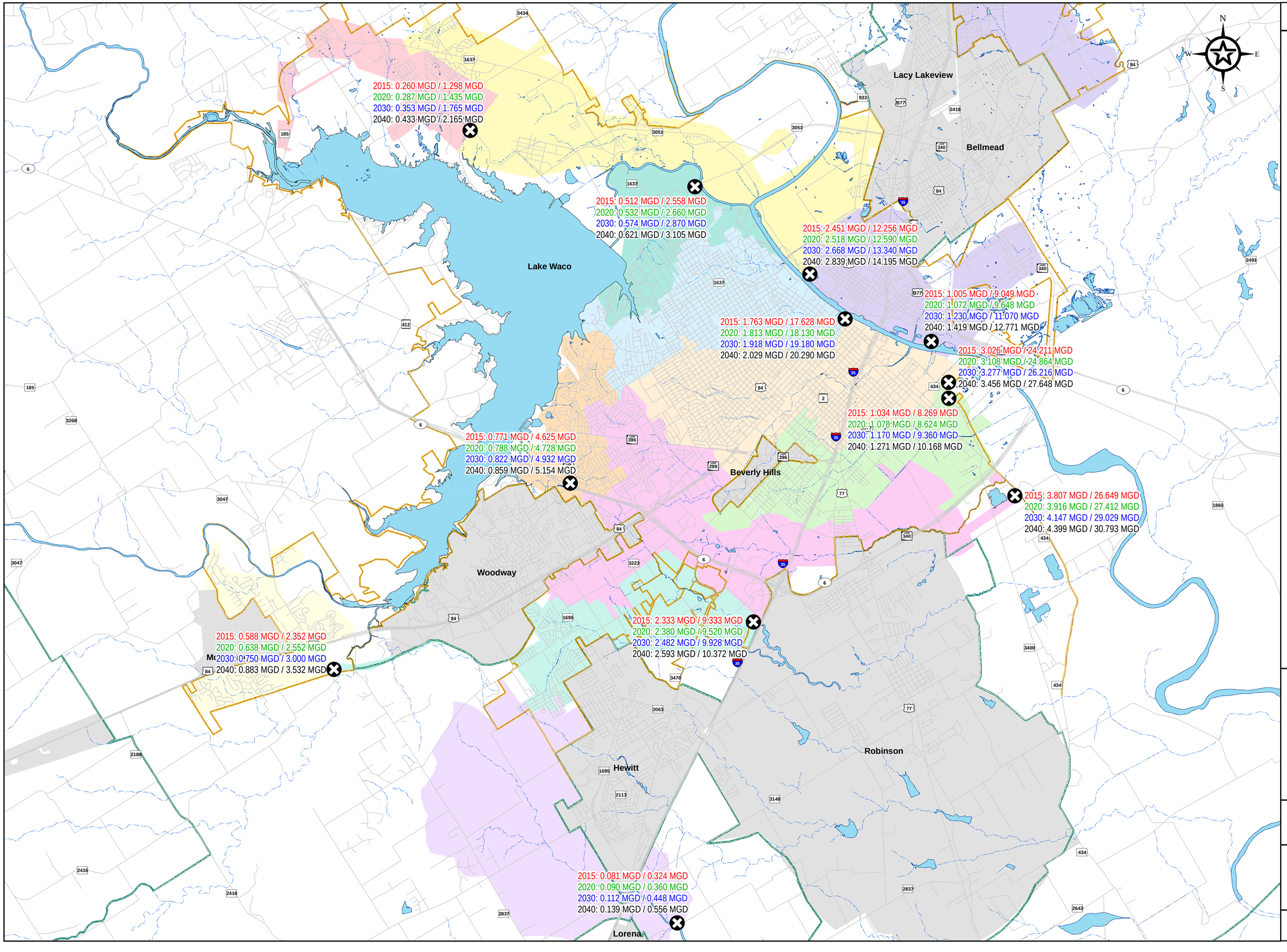
Major Wastewater Basin	Avg. Day Flow Rates (gpcd)*	Avg. Dry Weather Flow (MGD)	Wet Weather Peaking Factor***	Peak Wet Weather Flow (MGD)
Barron's Branch	65	1.918	10	19.180
Bosque River	75	0.574	5	2.870
Brazos	55	3.277	8	26.216
Bull Hide**	-	0.112	4	0.448
Carver	70	2.668	5	13.340
Cottonwood	80	4.147	7	29.029
Flat Creek	75	2.482	4	9.928
MLK	70	1.230	9	11.070
Primrose	60	1.170	8	9.360
Speegleville	135	0.750	4	3.000
Twin Bridges	110	0.822	6	4.932
Village Lake	75	0.353	5	1.765
Total		**19.50**	**-**	**131.1**

*gpcd values are based on three month winter average residential water meter billing data.
**Bull Hide Basin values were projected using the "Combined Scenario" growth rate of 2.17%.
*** Number shown is the major wastewater basin average based on a 5-year 6-hour rain event. Reference *Chapter 4 – Temporary Flow Monitoring* for explanation and determination of peaking factors.

Table 3-16: Summary of Projected Wastewater Flows by Major Wastewater Basin (2040)

Major Wastewater Basin	Avg. Day Flow Rates (gpcd)*	Avg. Dry Weather Flow (MGD)	Wet Weather Peaking Factor***	Peak Wet Weather Flow (MGD)
Barron's Branch	65	2.029	10	20.290
Bosque River	75	0.621	5	3.105
Brazos	55	3.456	8	27.648
Bull Hide**	-	0.139	4	0.556
Carver	70	2.839	5	14.195
Cottonwood	80	4.399	7	30.793
Flat Creek	75	2.593	4	10.372
MLK	70	1.419	9	12.771
Primrose	60	1.271	8	10.168
Speegleville	135	0.883	4	3.532
Twin Bridges	110	0.859	6	5.154
Village Lake	75	0.433	5	2.165
Total		**20.94**	**-**	**140.7**

*gpcd values are based on three month winter average residential water meter billing data.
**Bull Hide Basin values were projected using the "Combined Scenario" growth rate of 2.17%.
*** Number shown is the major wastewater basin average based on a 5-year 6-hour rain event. Reference *Chapter 4 – Temporary Flow Monitoring* for explanation and determination of peaking factors.



LEGEND

- Barron's Branch
- Bosque River
- Brazos
- Bull Hide
- Carver
- Cottonwood
- Flat Creek
- Martin Luther King
- Primrose
- Speegleville
- Twin Bridges
- Village Lake
- Discrete Flow Locations of Major Basins
  - 2015 Flows: ADF / PWWF
  - 2020 Flows: ADF / PWWF
  - 2030 Flows: ADF / PWWF
  - 2040 Flows: ADF / PWWF
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 2000 4000 8000

GRAPHIC SCALE (FEET)

Figure 3-9: Flows Associated with Major Wastewater Basins

G:\GIS\Projects\1-02231\Maps\Pop and Flow Projection Map.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

CHAPTER 4 – TEMPORARY FLOW MONITORING

4.1 Background

Flow monitoring and rainfall monitoring occurred over a 3-month period from March 1, 2014 through May 31, 2014. **The purpose of the temporary flow monitoring is to evaluate capacity and system performance during dry and wet-weather periods, quantify inflows and infiltration rates under various storm events, and provide system capacity information during dry and wet weather periods.** Services completed as part of the temporary flow monitoring include: site investigation and selection, installation, maintenance, data collection and removal of the monitoring equipment, and an engineering evaluation of the collected data. The data collected was used to evaluate system performance and provide real flows to calibrate predicted flows within the hydraulic model. The flow metering empirical data is especially useful in the wet weather calibration of the model, as it helps determine the actual system performance when it rains.

4.1.1 Definitions

The following terms are used to describe the wastewater flows in the collection system:

Infiltration – Groundwater that enters a wastewater system from the surrounding soil through such sources as defective pipes, separated pipe joints, service connections, or defective manholes.

Inflow – Stormwater runoff that directly enters a wastewater system from sources such as roof drains, yard drains, manhole covers, cross connections between storm sewers and sanitary sewers, storm waters, surface runoff, or drainage.

Rainfall Derived Inflow and Infiltration (RDII) - Inflow and infiltration that occurs as a result of a rainfall event.

Average Dry Weather Flow (ADWF) - The average of all daily flow comprised of base infiltration, residential and commercial flows in the absence of rainfall derived inflow or infiltration.

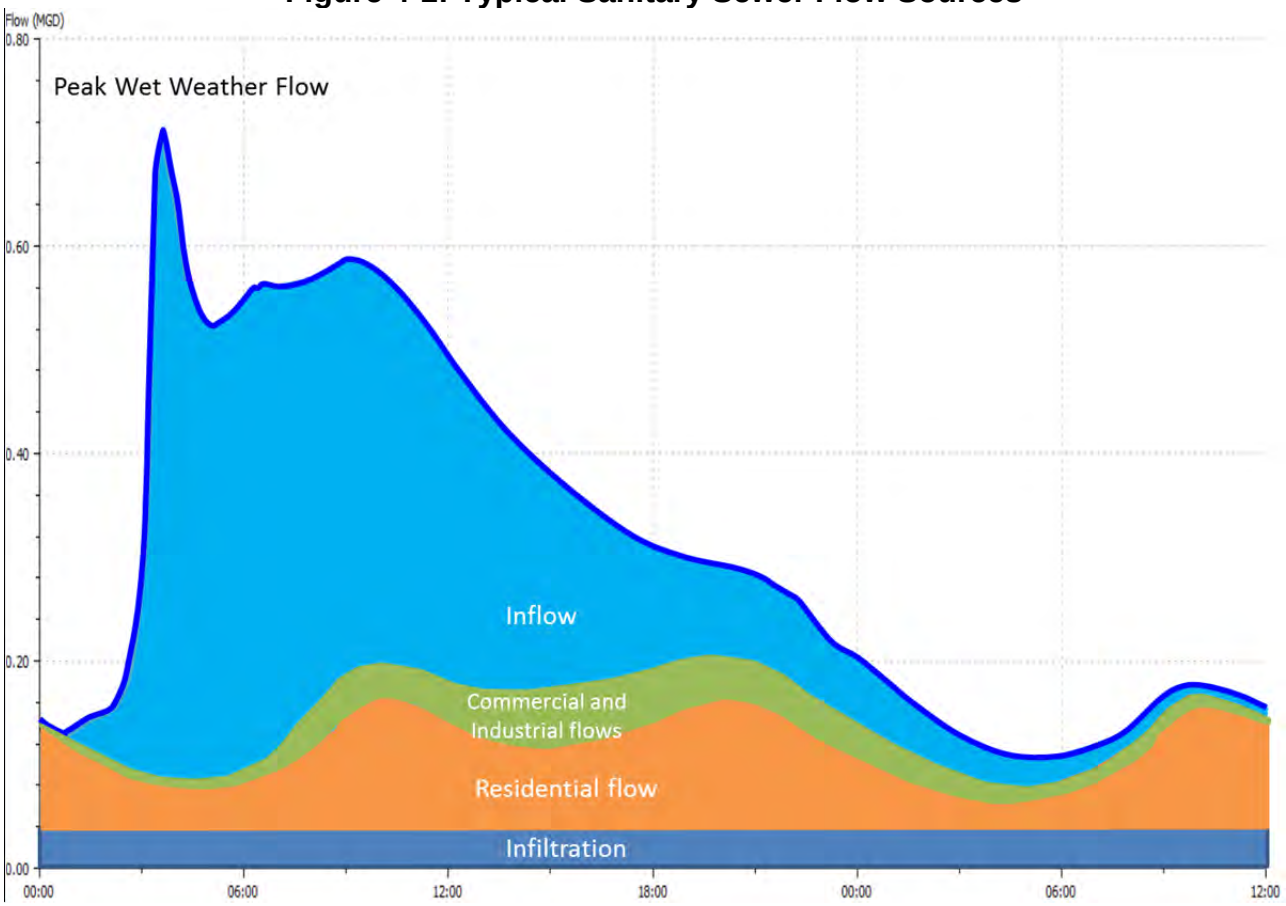
Peak Wet Weather Flow (PWWF) – The highest flow that occurs from an observed or modeled rainfall event.

Discrete Flow - The measured flow for an area that is calculated by subtracting measured flow from contributing areas. Not necessarily the flow measured at a specific flow monitoring location.

Peaking Factor – The ratio of the PWWF to the ADWF, which is a measure of the amount of rainfall derived inflow or infiltration that enters the contributing portion of the system.

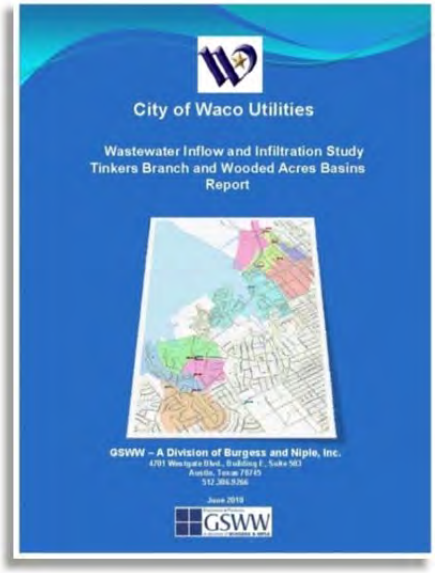
Figure 4-1 shows how the different flow sources combine to create the total flow within the collection system.

Figure 4-1: Typical Sanitary Sewer Flow Sources



4.2 Equipment Location and Rainfall Analysis

4.2.1 Flow Meter Locations



For a collection system the size of Waco's, the Team originally recommended that 50 temporary flow monitors were desirable in order to thoroughly investigate the system. Due to budget limitations, the City directed the Team to move forward with a total of 25 meters. Based upon this guidance, the Team distributed the planned flow meters within the collection system into 23 meter basins ranging in size from 50,000 linear feet to 300,000 linear feet of contributing pipes**. The planned locations were then vetted with City staff. A couple of the locations were adjusted to maximize the system configuration as well as to provide beneficial data as the model was developed.**

An additional temporary flow meter, TB0A, was also used for model calibration. The meter data for this location was taken from the June 2010 Tinker's Branch and Wooded Acres Basin Wastewater Inflow

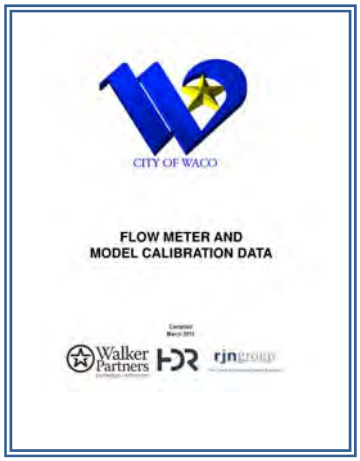
and Infiltration Study Report authored by GSWW, Inc. The addition of this meter location results in 24 separate meter basins. Two of the 25 meters installed for this project did not have a discrete associated meter basin. Those two are CW05 which measures flows downstream of CW07 without additional service area and the OF01 meter at the diversion structure at Jefferson and 3rd.

Continuous flow monitoring occurred at the 25 flow monitoring sites over a 90-day period. Flow depth and velocity was recorded at five-minute intervals for each monitoring location utilizing ADS 5000 AG flow meters. Manual depth and velocity readings (velocity profiles) were taken bi-weekly for the temporary meters to verify the metered data. The flow monitoring sites with associated basin data are listed in Table 4-1 and the locations are illustrated in Figure 4-2.

Table 4-1: Flow Meter Locations

Meter	Pipe Diameter (in)	Address	Basin Footage (LF)	Basin % of Total Footage
BB01	42	201 N. University Parks Dr	151,764	4%
BB02	21	1521 Alexander Ave	118,219	3%
BB03	18	2798 Glendale	194,689	5%
BB04	15	504 N 6th Street	188,891	5%
TB0A*	21	2320 Lake Shore Dr.	129,651	3%
BZ01	15	2300 S University Parks Dr	109,123	3%
BZ02	24	27 Bagby Ave	54,044	1%
BZ03	18	1225 S Jack Kultgen Expwy	138,414	4%
BZ04	14	898 N 30th St	161,204	4%
BZ05	36	400 S 4th St	229,803	6%
BZ06	27	2400 Webster Ave	152,387	4%
CW04	15	1413 S Jack Kultgen Expwy	53,190	1%
CW06	24	Remote	140,613	4%
CW07	30	4520 Hiland Dr	167,238	4%
CW08	15	900 Valley Mills	112,365	3%
FC02	21	880 Panther Way	434,513	12%
MK01	24	800 E 7th St	82,567	2%
MK04	30	758 S MLK Blvd	164,961	4%
MK05	15	305 Mill Street	41,200	1%
PR01	36	Gurley Lane	117,751	3%
PR02	15	2619 Primrose	152,772	4%
TB01	21	7321 Bosque	111,340	3%
TB02	16	1936 La Porte	146,009	4%
VL01	21	4701 Steinbeck Bend Dr	401,735	11%

* - The meter data for this location was taken from the June 2010 Tinker's Branch and Wooded Acres Basin Wastewater Inflow and Infiltration Study Report authored by GSWW, Inc.



All meters were used to calibrate the model as discussed in Chapter 5. See the separate data notebook titled Flow Meter and Model Calibration Data for the final flow monitoring data.

4.2.2 Rain Gauge Locations

Rainfall data was recorded at ten locations within the City. Rain gauges with an accuracy of 0.01 inches were used to record rainfall continuously throughout the flow monitoring period. The rain gauge locations are listed in Table 4-2 and illustrated in Figure 4-2.

Table 4-2: Rain Gauge Locations

Rain Gauge	Address
WC-01	6001 Flat Rock Rd
WC-02	909 A North Loop Dr
WC-03	201 Colcord Ave
WC-04	4620 Airport Rd
WC-05	3110 Herring
WC-06	4609 Sanger Ave
WC-07	2315 Robinson Dr
WC-08	1928 SH 6
WC-09	9120 Old McGregor Rd
WC-10	809 Country Lane Rd

4.2.3 Rainfall Analysis

An important part of any rainfall derived inflow and infiltration (RDII) analysis is the collection and assessment of rainfall data (volume and distribution). Rainfall data was collected in conjunction with the flow monitoring equipment during the 90-day period.

A significant rain event can be defined as an event producing a total of one or more inches of rainfall or having a peak intensity of 1 in/hr or greater. For an appropriate wet weather analysis of the flow data, it is desirable that a significant rain event occurs following several smaller rain events and that it is fairly uniform across the city. The prior smaller rain events will generally cause the surrounding ground to become saturated. This situation in turn will allow infiltration into the collection system to occur since the soil has absorbed the previous rainfall.

WC-01
Village Lake LS

VL01

TB0A

WC-04
Raw Water Station

Lake Waco

BB02

WC-03
Riverside Treatment Plant

MK05

OF01

BB01

MK04

MK01

BB04

BB03

WC-05
New Station

BZ05

BZ02

BZ01

PR01

BZ04

BZ03

BZ06

WC-02
Chicken Shack LS

Lacy Lakeview

Bellmead

TB02

CW08

WC-06
Westview GST

PR02

TB01

Beverly Hills

CW07

WC-08
Woodway LS

WC-07
New Station - No Facility

CW06

CW04 CW05

Woodway

WC-09
Old McGregor Rd GST

Robinson

WC-10
No Name GST

McGregor

FC02

Hewitt

LEGEND

- Rain Gauge
- Flow Meter
- Flow Meter Basin Boundary
- City of Waco Gravity Wastewater Line
- WMARSS Gravity Interceptor
- WMARSS Force Main
- Stream, Creek, River
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 1250 2500 5000

GRAPHIC SCALE (FEET)

Figure 4-2: Temporary Monitoring Locations

G:\GIS\Projects\1-02231\Maps\Flow Meter - Rain Gauge Map.mxd

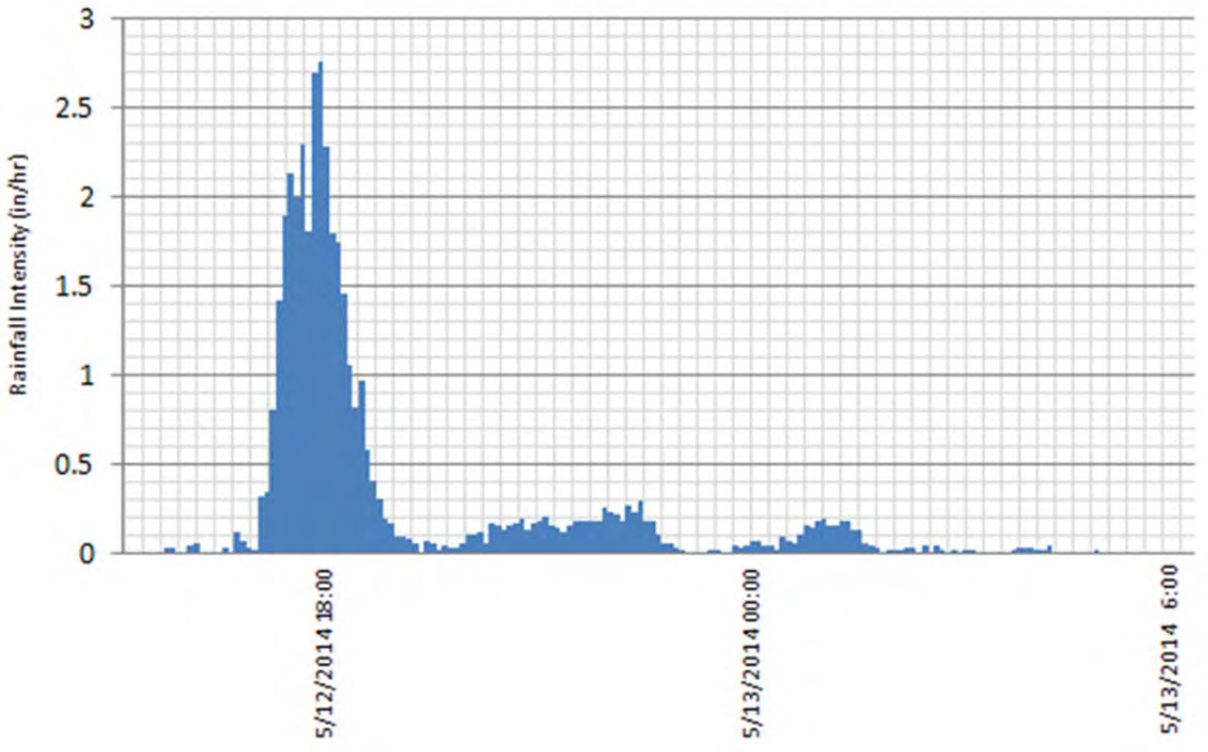
THIS PAGE IS INTENTIONALLY LEFT BLANK

Several smaller rainfall events were recorded during the monitoring period. These events produced highly variable precipitation levels over the entire monitoring area. This caused a variable resultant system response not useful for model calibration. Table 4-3 lists the average measured rainfall for the rain events experienced during the monitoring period.

The May 12, 2014 rainfall event covered the entire city with an average rainfall depth of 3.35 inches over a 22 hour period.

Only one rainfall event (May 12th) was considered appropriate for model calibration during the monitoring period. This rainfall event covered the entire city with an average total rainfall depth of 3.35 inches over a 22 hour period. The event included a main rainfall cell that occurred during the middle of the episode. **The May 12th rainfall cell varied across the City, but roughly corresponded to a 2 to 5 year front loaded 12 hour event.** This rainfall event had a recorded peak intensity of 5.28 in/hr at WC-8 and an average intensity of 3.5 in/hr. The rainfall average depth for the main part of the event was 2.74 inches over a 6 hour period. Figure 4-3 displays the average rainfall intensity measured by all gauges during the May 12th event.

Figure 4-3: Average Rainfall Intensity During the May 12, 2014 Calibration Event



Two other events were large enough to use for verification events. There are also several smaller rainfall events of less than 1 inch total rainfall depth that did not adequately cover the entire city. Rainfall statistics for the monitoring period are provided in Table 4-3. The rest of the metering period was more or less dry.

THIS PAGE IS INTENTIONALLY LEFT BLANK

Table 4-3: Rainfall Data for Monitoring Period

Date	Avg. Rainfall Depth for All Gauges (in)	Peak Intensity (in/hr)	Total Duration (hrs)
28-Mar	0.29	0.98	1
3-Apr	0.11	0.55	1.5
6-Apr	0.69	1.11	0.25
13-Apr	0.11	0.27	3
8-May	**1.95**	**2.38**	**24**
12-May	**3.35**	**2.75**	**22**
13-May	0.14	0.16	6
24-May	0.05	0.59	4
25-May	0.58	1.01	6
26-May	0.16	0.18	10
27-May	**1.31**	**1.64**	**23**

Due to technical issues, the five rain gauges attached to flow meters and rain gauges WC-03 and WC-05 all stopped working on April 27th at midnight and all came back online on May 13th between the hours of 12:45 pm and 2:15 pm. These rain gauges are all in the immediate vicinity of each other, roughly located in the downtown area and extending westwards in the Waco area. To fill the missing data gap for these two rain gauge locations, a weighted average of nearby rain gauges was calculated based on the nearest working rain gauges. Rain gauge WC-03 was averaged from rain gauge WC-02 and WC-07 and rain gauge WC-05 was averaged from rain gauges WC-04 and WC-06. These rain gauge pairings also roughly lined up with the direction of the rainfall events. The five rain gauges co-located with the flow meters were not used in the calibration.

The May 8, 2014 event featured scattered showers over 24 hours with most of the rainfall falling in a 5 hour window in two peaks, one at the start and the other at the end of the 5 hours. This storm was not ideal for model calibration but was acceptable for model verification. Although the May 27, 2014 event duration covers almost an entire day, it was actually 3 small events of about 4 hour duration each separated by roughly 4 hours. This storm was not good for model calibration but was acceptable for model verification.

4.3 Flow Monitoring Analysis

4.3.1 Flow Meter Schematic

The temporary flow meter schematic shown in Figure 4-4 summarizes the connectivity of each of the temporary flow meters to the collection system network. Using this schematic and the measured flow data, the existing dry and wet weather flows where determined.

Figure 4-4 shows the mass balance of the metered flow as it travels through the system. Peaking factors, the numerical representation of how reactive the system is to a rainfall event, were calculated by taking the instantaneous metered Peak Wet Weather Flow (PWWF) during the May 12, 2014 event and dividing by the Average Dry Weather Flow (ADWF) for each meter basin.

The wet weather peaking factors tend to drop as the flow travels from the upper end of the collection system down through the pipe network because storage volume starts to attenuate the peaks and backwater effects constrain flows at bottlenecks in the system.

Analysis of the recorded PWWF and resulting peaking factors shown in Figure 4-4 reveal two things about the Waco system. **First, there are areas of relatively high wet weather peaks that result from rainfall derived inflow and infiltration.** This indicates there are areas of the collection system that receive inflow from runoff surfaces which quickly increase the flows in these portions of the system. **Second, the wet weather peaking factors tend to drop as the flow travels from the upper end of the collection system down through the pipe network because storage volume starts to attenuate the peaks and backwater effects constrain flows at bottlenecks in the system.**

4.3.2 Dry Weather Analysis

Flow data analysis consists of analyzing both wet weather and dry weather periods. The study of dry weather (and low groundwater) periods is performed in order to establish baseline flows. During dry weather flow periods there is not an apparent system reaction to rainfall. The analysis of dry weather flow data consists of identifying average daily dry weather flows and estimating dry day base infiltration at each monitoring location.

The period that defines dry weather flow is seven continuous days, occurring prior to a wet weather event or following the system's return to an average diurnal (daily) trend after a rainfall event. This "dry weather week" is applied to calculate a dry weather average daily flow and a dry weather peak flow rate. Dry weather average daily flow is defined as the average wastewater flow that occurs during dry weather periods over 24 hours during the "dry weather week". Dry weather peak flow rate is the highest flow rate that occurs during dry weather flow periods measured over a two-hour period.

The "dry weather week" chosen for the monitoring period occurred from May 1 to May 8, 2014.

For the flow monitoring period, the longest period of dry days occurred from May 1 to May 8, 2014. Therefore, this period was chosen for the "dry weather week" flow calibration. For each basin, measured dry weather data for several days was gathered, averaged and normalized by the total flow to create hourly factors and a diurnal flow profile. A separate profile was created for weekdays and weekends to model flow profile differences between these periods. The profiles also vary depending on land use split between residential and commercial.

TEMPORARY FLOW METER SCHEMATIC

VL

CR

MLK

BR

BB

BZ

PR

TB

CW

SP

FC

VL01
ADWF: 0.39 MGD
PWWF: 5.50 MGD
Peaking Factor: 14.2

TB0A*
ADWF: 0.37 MGD
PWWF: 1.78 MGD
Peaking Factor: 4.8

BB01
ADWF: 1.90 MGD
PWWF: 6.94 MGD
Discrete: 1.08 MGD
Peaking Factor: 3.7

BB02
ADWF: 0.67 MGD
PWWF: 7.57 MGD
Discrete: 0.53 MGD
Peaking Factor: 11.3

BB03
ADWF: 0.14 MGD
PWWF: 2.08 MGD
Peaking Factor: 15.4

BB04
ADWF: 0.66 MGD
PWWF: 6.72 MGD
Peaking Factor: 10.2

OF01
ADWF: 0.51 MGD
PWWF: 3.43 MGD
Peaking Factor: 6.7

BZ05
ADWF: 1.63 MGD
PWWF: 13.11 MGD
Discrete: 0.64 MGD
Peaking Factor: 8.0

BZ02
ADWF: 0.78 MGD
PWWF: 3.13 MGD
Discrete: 0.62 MGD
Peaking Factor: 4.0

BZ01
ADWF: 6.85 MGD
PWWF: 27.37 MGD
Discrete: 2.03 MGD
Peaking Factor: 4.0

BZ04
ADWF: 0.47 MGD
PWWF: 3.80 MGD
Peaking Factor: 8.1

BZ03
ADWF: 0.16 MGD
PWWF: 1.69 MGD
Peaking Factor: 10.5

BZ06
ADWF: 0.52 MGD
PWWF: 5.12 MGD
Peaking Factor: 9.8

MK05
ADWF: 0.08 MGD
PWWF: 0.80 MGD
Peaking Factor: 9.4

MK04
ADWF: 0.31 MGD
PWWF: 2.70 MGD
Peaking Factor: 8.6

MK01
ADWF: 0.18 MGD
PWWF: 1.60 MGD
Peaking Factor: 8.8

PR01
ADWF: 0.90 MGD
PWWF: 7.21 MGD
Discrete: 0.47 MGD
Peaking Factor: 8.1

PR02
ADWF: 0.43 MGD
PWWF: 4.52 MGD
Peaking Factor: 10.3

TB02
ADWF: 0.62 MGD
PWWF: 5.89 MGD
Peaking Factor: 9.5

TB01
ADWF: 0.93 MGD
PWWF: 5.20 MGD
Discrete: 0.31 MGD
Peaking Factor: 5.6

CW08
ADWF: 0.42 MGD
PWWF: 2.34 MGD
Peaking Factor: 5.5

CW07
ADWF: 1.16 MGD
PWWF: 8.15 MGD
Discrete: 0.74 MGD
Peaking Factor: 7.0

CW04
ADWF: 0.28 MGD
PWWF: 4.35 MGD
Peaking Factor: 15.2

CW05
ADWF: 1.33 MGD
PWWF: 9.25 MGD
Discrete: 0.17 MGD
Peaking Factor: 7.0

CW06
ADWF: 2.97 MGD
PWWF: 9.02 MGD
Discrete: 2.04 MGD
Peaking Factor: 3.2

FC02
ADWF: 1.62 MGD
PWWF: 6.32 MGD
Peaking Factor: 3.9

WMARSS CENTRAL WASTEWATER TREATMENT PLANT

* TB0A – Tinkers Branch 0A is from the temporary flow metering B&N performed in 2010 and replaced proposed meter BR01.
– Discrete flow refers to the ADWF produced within the meter basin (Basin ADWF – Upstream Basin(s) ADWF).
– PWWF values and resulting peaking factors are for the highest recorded flows during the monitoring period (March – May, 2014)

LEGEND

- BARRON'S BRANCH (BB)
- BOSQUE RIVER (BR)
- BRAZOS (BZ)
- CARVER (CR)
- COTTONWOOD (CW)
- FLAT CREEK (FC)
- MARTIN LUTHER KING (MLK)
- PRIMROSE (PR)
- SPEEGLEVILLE (SP)
- TWIN BRIDGES (TB)
- VILLAGE LAKE (VL)

DISCRETE METER BASIN

DIVERSION STRUCTURE

INLINE METER BASIN

FLOW PATH

OVERFLOW

CITY OF WACO

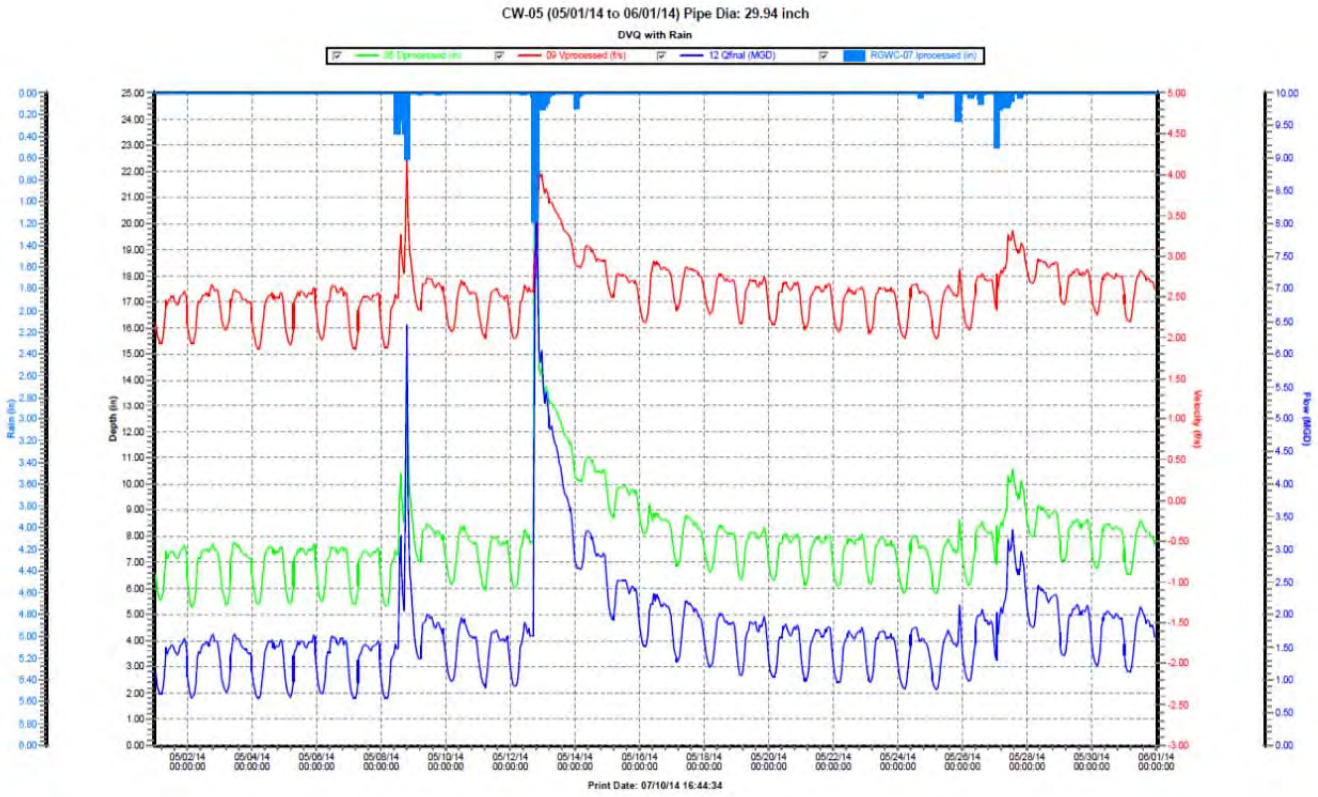
N.T.S.

Figure 4-4: Temporary Flow Meter Schematic

THIS PAGE IS INTENTIONALLY LEFT BLANK

An example flow meter data graph for meter CW-05 for the month of May, 2014 is presented in Figure 4-5. The flow meter graphs show the measured depth and velocity in the pipe segment where the meter was installed and the calculated flow based on those measurements. The shape of each graph describes how the flow in this portion of the collection system changes daily during both dry weather conditions and for any rainfall events during the metering period. All of the flow meter graphs for the three month monitoring period are included in the separate data notebook titled Flow Meter and Model Calibration Data.

Figure 4-5: Example Flow Meter Data Graph
(Meter CW05 – May, 2014)



The following are general observations on the dry weather flow meter data. The (raw) flow meter data and the scattergraph plots of that data can provide insight into what is happening hydraulically in the system**. In general for the Dry Weather Flow, many of the flow meters show some degree of backwater from downstream conditions with a few having significant influence from downstream.** These are believed to be mostly due to the interaction with the WMARSS system and in particular the WMARSS lift station operations. More general comments on the flow meter data recorded for this study are provided in the separate data notebook titled Flow Meter and Model Calibration Data.

Flow meters BB03, BZ03, CW04, MK01, MK04 and MK05 exhibited low dry weather flows (<0.3 MGD) readings and low velocities which result in variable or "spiked" flow readings. The data indicates that the meters have trouble reading the low velocities and this translates to readings being highly variable. This results in the calculated flow data varying erratically during these periods of low flow, as this value is based on the velocity and depth readings. As a result, less confidence was assigned to these meters for the dry weather peaks and volumes. Some meters, notably meters BB01, MK01, MK04 and MK05 also experienced backwater effects that slowed down the flows and reduced the velocities during wet weather events. This had a similar effect on the variability of the meter readings under these circumstances.

The variability of the flow measurements at these meters effects the depth, velocity, and flow curves that are used to calibrate the model of the system and have to be interpreted individually to make sure the results make sense and the actual peaks and correct volumes are used. The explanation of how the variability of these meters was handled during model calibration is described in Chapter 5.

4.3.3 Wet Weather Analysis

Sanitary sewer system flows are generally comprised of base wastewater flows along with groundwater infiltration and storm water inflow. **A comparison of flow monitoring data obtained from both dry weather and wet weather periods provide a quantification of RDII.** This is calculated by subtracting flow measured during a rainfall event from the average flow from all "Dry Days" during the monitoring period.

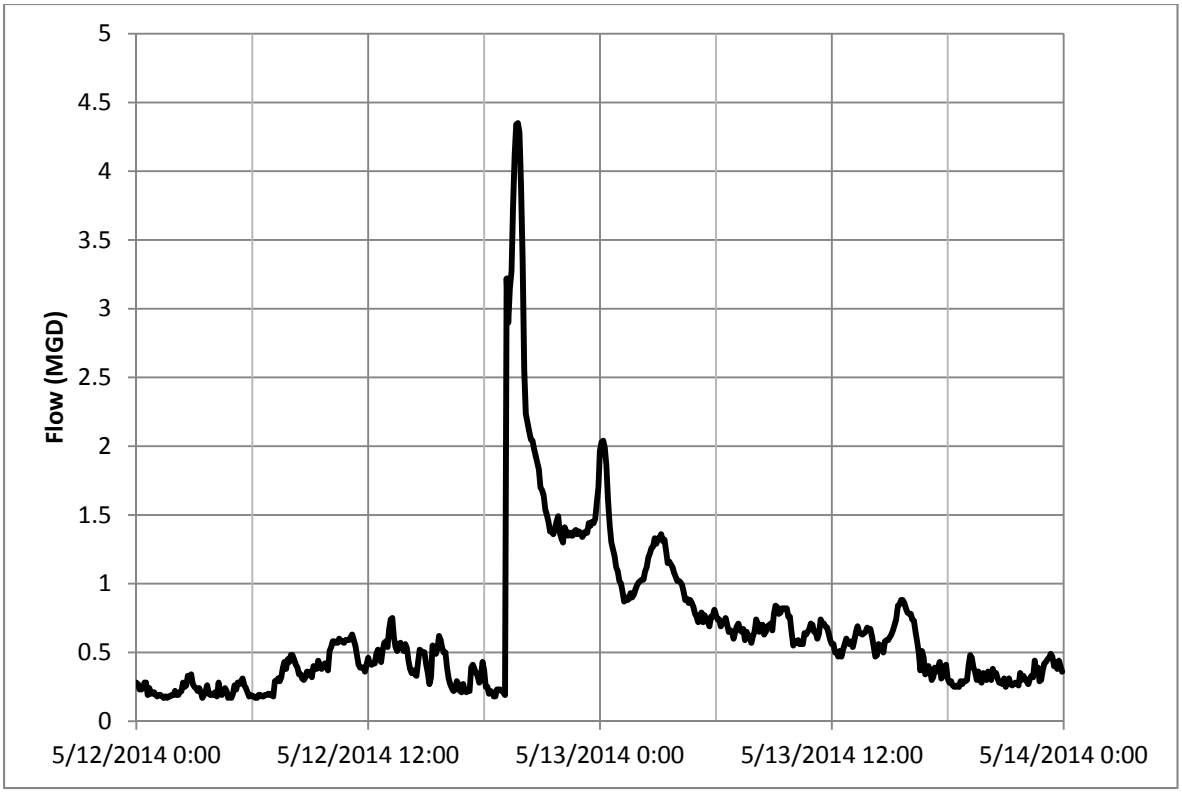
The highest daily total rainfall was recorded on May 12th. As discussed previously, it was opportune that a significant rainfall event occurred prior to this event on May 8th which generally triggered the surrounding ground to become saturated.

An example of a wet weather flow meter data graph from the May 12th event is presented in Figure 4-6. The graph shows the system response at meter CW04 for a 48 hour period from before the beginning of the recorded rainfall to the time where it dissipates back to the pre-rainfall event condition. This enables the analysis of both inflow and infiltration.

Inflow normally begins to occur during the rainfall event and immediately thereafter. Infiltration is a delayed system reaction to rainfall percolation through the soil into the sewer system.

Inflow and infiltration is defined as the extraneous flow that enters a sewer system both during and after rainfall episodes. Inflow normally begins to occur during the rainfall event and immediately thereafter causes a rapid rise in flows. Infiltration is a delayed system reaction to rainfall percolation through the soil into the sewer system and contributes to the extended tail of the response curve.

Figure 4-6: Flow Meter CW04 Response to May 12, 2014 Rainfall Event

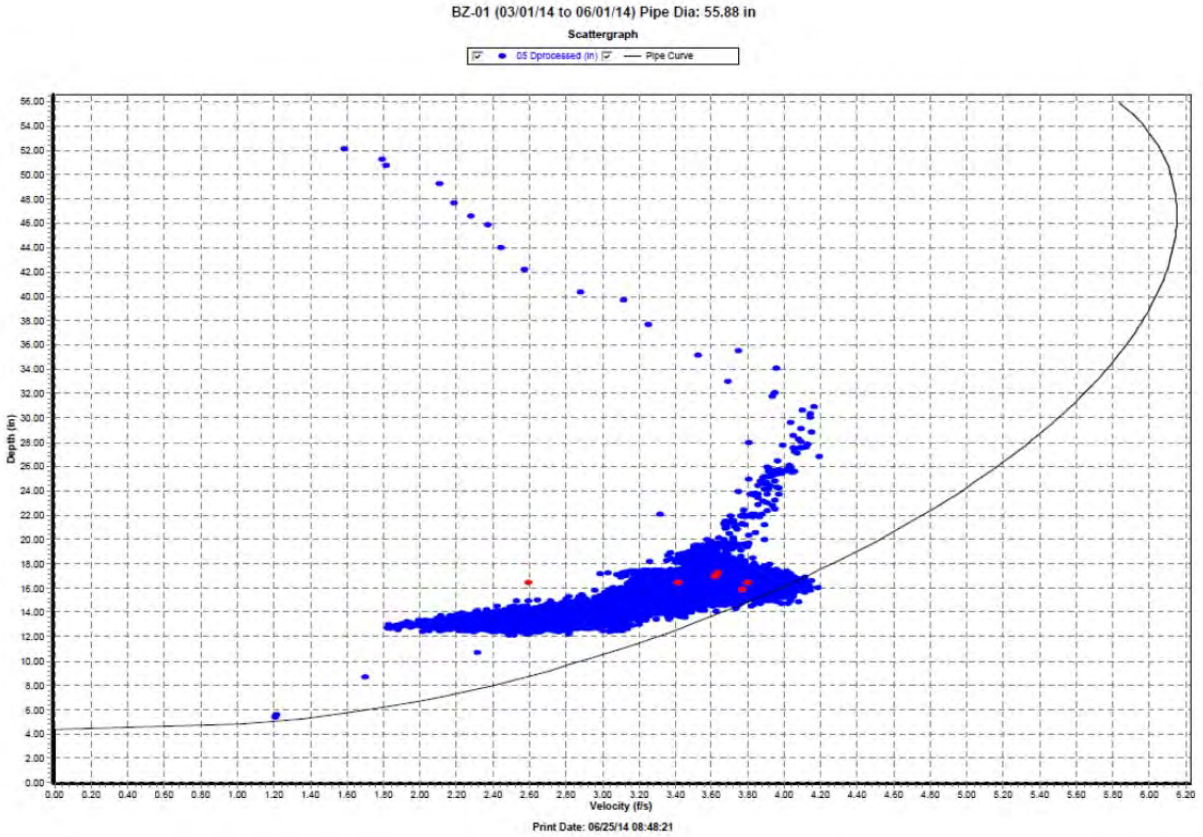


By studying the flow meter data and the associated scatter graphs, it was established that the WMARSS collection system and particularly the WMARSS lift stations significantly affect the flow in Waco's collection system when comparing the flow depth and velocities for the neighboring flow meters. An example of a lift station operation affecting the flow can be seen in the scatter graph data in Figure 4-7, which shows meter BZ01 being affected by the Transfer Lift Station. Meters MK01, MK04 and MK05 are similarly affected by the La Salle and Carver Lift Stations.

Figure 4-7 shows a number of measurements where velocities dropped as the depths increased due to the backwater effects created by the downstream conditions. If the pipe is flowing normally, without downstream influence on the hydraulics, then you would expect velocity to increase with depth as the flows increase along the theoretical parabola shown in the graph. The scatter graph shows that as depth increases velocities actually decrease, which indicates something is backing the water up in the pipe. The something in this case is the operating level of the lift station.

Meters CW04, CW05, BZ02 and PR01 also demonstrate significant amounts of backwater effects showing up in meters that connect close to the WMARSS system. There are observations on the scatter graphs of the wet weather flow meter data included in the data notebook titled Flow Meter and Model Calibration Data.

Figure 4-7: Example Flow Meter Scatter Graph Showing Backwater Effects at BZ01



CHAPTER 5 – SANITARY SEWER SYSTEM MODEL

5.1 Modeling Software Selection

5.1.1 Background

The City of Waco developed its first hydraulic model in 1994. **The model included portions of the West Bank Interceptor and was developed to help identify wet weather related hydraulic bottlenecks in the upper reaches of the interceptor.**

In 1997 the City expanded its hydraulic modeling efforts by preparing a detailed model (pipes 12" in diameter and larger) for the portions of the City served by the West Bank Interceptor.

During this period the Brazos River Authority (BRA) engaged in a hydraulic modeling effort of the Waco Metropolitan Area Regional Sewerage System (WMARSS). The BRA owned, operated, and maintained the WMARSS interceptor system prior to 2004. This hydraulic model was focused on high level planning issues and did not contain the same level of detail as the Waco West Bank model.

In February 2004, the municipalities in the greater Waco area formed a coalition and acquired the WMARSS interceptor system from the BRA. In an effort to streamline operations in the WMARSS and City of Waco service systems, **the City of Waco engaged a consultant to combine both of the existing hydraulic models into a common platform and recalibrate the combined model. Recommendations for hydraulic capacity improvements were also made as a function of this engagement.**

In 2012 the combined model was updated to include the recently constructed Flat Creek Interceptor and to reallocate wastewater flows to that interceptor. Additional modifications were made to the model to reflect significant changes to the collection system since the last model update. The hydraulic model prepared for this master planning effort utilizes some of the previous model's pipe network and flow allocations. Detailed information regarding the hydraulic modeling effort undertaken for this master plan is presented in this chapter.

Selection of InfoWorks CS for sewer modeling provides the following advantages:

- ***Same software COW has used historically***
- ***Same software vendor as the water system model***
- ***Software integrates well with GIS***

5.1.2 Software Selection

The selection of an appropriate hydraulic modeling software package for the City of Waco is influenced by a number of factors. Although all major commercially available modeling software platforms were evaluated, the Project Team selected InfoWorks CS by Innovyze. The selection was based first and foremost on the features available within the software, such as ability to approximate backwater flow conditions in pipelines, modeling sanitary sewer overflows, available features for lift station modeling, and compatibility with the City of Waco Geographic Information System (GIS).

Additional consideration was given to compatibility to other planning and modeling efforts being conducted by the City of Waco. The City of Waco has concurrently engaged the engineering team of The Wallace Group and Freese & Nichols to develop a master plan for its potable water system. Coordination between the wastewater and water master planning teams reinforced the value of consistency and compatibility across both modeling platforms. The water master planning group selected H2OMap Water for its modeling efforts. Both software packages are supported by Innovyze. This feature provides consistency across the software user interface, data structures, and support requirements. **Additionally, both H2OMap Water and InfoWorks CS have been used by the City of Waco for previous modeling efforts.**

In 2005 the City of Waco purchased an InfoWorks CS software license in support of the hydraulic modeling efforts being undertaken at that time.

In 2005 the City of Waco purchased an InfoWorks CS software license in support of the hydraulic modeling efforts being undertaken at that time. The software license is not limited by the number of nodes in the model. The software vendor for InfoWorks CS requires an annual maintenance fee based on the type of software license. Unfortunately, the City of Waco has not maintained the annual maintenance agreement and would be required to pay a fee to update and reactivate the licensing. As a function of this activity, the City would be eligible to receive support and updated software.

5.2 Hydraulic Model Development

5.2.1 Purpose

The hydraulic model of the City of Waco's wastewater collection system was developed in support of this master planning effort in order to provide an assessment of the system's performance and capacity for existing conditions under various flow scenarios, including observed dry and wet weather conditions and design storm conditions. The model was further utilized to test and enhance proposed system improvements under these conditions. A number of system improvements are recommended to improve the system's performance under these conditions. The model was also used to investigate various planning scenarios based on increases and decreases in the population of the City (planning horizons). A number of improvements are proposed in order to accommodate changes in future population values and distributions.

5.2.2 Data Collection

Available data was gathered for the wastewater collection system's physical attributes to facilitate model construction. Multiple sources of data were used to develop a collection system model with sufficient detail to generate reliable and verifiable results. The data was collected from the following sources:

- City's GIS Database – Current GIS wastewater system files detailing manholes, gravity collection lines, force mains and lift stations were acquired for model inputs.
- Record Drawings – Reviewed where available to determine pipe inverts, diameters and lift station dimensions when this data was not populated in the GIS database.
- Field Survey Data – Field surveys were conducted for critical line segments where no GIS or as-built data was available.
- Temporary Flow Monitoring Data – Described in Chapter 4.
- City Records – Additional City data such as water billing records (Chapter 3) and lift station operational data (Chapter 6).
- Personal Communication with City Staff – The institutional knowledge of the City operations and planning staff was used to verify system response and to identify known problem areas in the system.

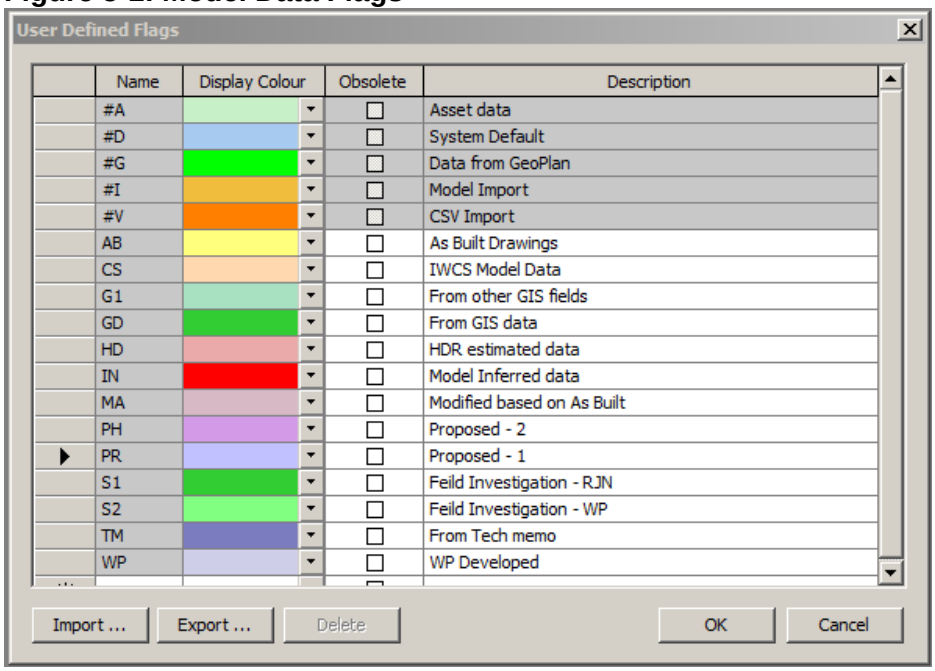
5.2.3 Model Physical Attributes Development

Once the various types of data required for the model were collected, the physical model network build could begin. In InfoWorks the physical model network is represented in a database. This database is used to store the physical attributes of the wastewater system, such as pipe diameter, segment length, invert elevations, connectivity data, manhole and pipe identities, etc.

One of the goals of the project was to reuse and vet existing model data where possible. Since the original hydraulic model was created using a predecessor software package called HydroWorks, a number of wholesale data manipulations were performed to update the locations of pipes and manholes to match current GIS data and manhole/pipeline identifiers were updated to match current standards. Additional manholes and pipelines were added from the City GIS data source. **Since the physical model network forms the backbone of the model, it is critical that the data used to build the network be as accurate as possible**.

In order to verify some missing or suspect data, selected field surveys were undertaken to confirm pipe connectivity and pipe elevations. While this effort was vital to the success of the model, it introduces additional sources of information into the modeling process. InfoWorks CS features a method to track the source(s) of data used in a model using data flags. Data flags are used extensively to note the source(s) of data for the physical model network. The data flags utilized in the City of Waco model are presented in Figure 5-1.

Figure 5-1: Model Data Flags



The physical model network includes all existing gravity wastewater pipes that are 12-inch and larger in diameter.

The physical model network includes all existing gravity wastewater pipes that are 12-inch and larger in diameter. In some cases, smaller diameter pipes were included to maintain system connectivity and to represent critical hydraulic structures such as constructed overflows, parallel pipe flow equalization pipes, and wet weather interbasin connections. Force mains for modeled lift stations were included regardless of pipe size. It should be noted that not all of the lift stations in the City of Waco system were included in the model. This is due to the configuration of the collection system and the limitation on pipe sizes in the model. The majority of the City's lift stations serve small areas and are not connected to the system by pipes that are 12-inch and larger in diameter.

Where the pipe material was known, or could be estimated based on pipe location, an initial pipe roughness was assigned based on the pipe material. If the material was unknown, then the Manning's Roughness Coefficient of 0.013 was used. The roughness coefficient was modified during calibration where required to better match observed data. Roughness value ranges used in the model are listed in Table 5-1.

Table 5-1: Modeled Pipe Roughness Ranges

Manning's "N" for Gravity Pipes		
	Low	High
Cast Iron	0.013	0.013
Concrete	0.013	0.013
Concrete Reinforced Polymer Mortar (CRPM)	0.010	0.013
Ductile Iron	0.012	0.013
Fiberglass	0.010	0.013
Polyvinyl Chloride Pipe	0.011	0.013
Vitrified Clay Pipe	0.011	0.015
Hazen-Williams C for Force Mains		
	Low	High
Ductile Iron	90	120

The WMARSS interceptor system and particularly the WMARSS lift stations have a significant effect on the flow in the City of Waco system. This is evident in the City of Waco wastewater flow metering data being affected by WMARSS pumping cycles.

The City of Waco's wastewater collection system connects to the WMARSS system in numerous locations. These entry points range from upstream of the siphon across the Brazos River in the Carver sanitary sewer basin (SSB), along the East Bank through the MLK SSB, over to the West Bank interceptor and tracing across the south side of the City through the Cottonwood SSB, out to the Flat Creek SSB, and the WMARSS Woodway Lift Station in the Twin Bridges SSB. Part of the Woodway Lift Station's flow is sent to a section of the City's sanitary sewer system before returning to the WMARSS lines. **This results in 25 modeled outflow connection points and one inflow from the WMARSS system.**

This large number of connection points, along with much of the area being relatively flat, causes the WMARSS interceptor system to exert a significant boundary condition for the Waco system. Therefore, it was concluded that the WMARSS system needed to be included in the model to provide the best calibration possible which results in a model that closely approximates actual system performance under various conditions. The WMARSS system is comprised of six major interceptors: East Bank, Lacy Lakeview, Bellmead, Cottonwood, Flat Creek, and Bull Hide Creek. The Bull Hide Creek interceptor was not included in the model as this section of the WMARSS system has no immediate effect on the City of Waco's collection system. The portion of the WMARSS interceptor system included in the City of Waco hydraulic model is shown in Figure 2-4 (page 2-22). The resulting model includes approximately 152 miles of sanitary sewer lines, which is about 21.6% of the total gravity lines and force mains in the City's system. The City portion of the model is split into 131 miles of gravity main sanitary sewer lines with 21 miles of force mains with 16 lift stations. There are an additional 37 miles of WMARSS gravity interceptors and 7 miles of force mains associated with 5 major lift stations modeled to aid with model calibration and model runs.

The following 21 lift stations (and their associated force mains) are additionally included in the hydraulic model:

- Bosque
- Church Rd
- Flat Rock
- Greenleaf
- Hillcrest
- Lakeshore
- Landon Branch
- Lindsey Hollow
- McLennan Co Jail
- Park Lake
- Riverside
- TSTC
- Twin Rivers
- Village Green
- Village Lake
- Wooded Acres
- Carver (WMARSS)
- La Salle (WMARSS)
- Main (WMARSS)
- Transfer (WMARSS)
- Woodway (WMARSS)

Sixteen City of Waco and five WMARSS lift stations are included within the hydraulic model.

As a function of the data gathering and physical model building processes it was determined that a majority of the WMARSS lift stations utilized variable speed pumps. In order to properly account for this type of pump in the model, a pump curve and operating procedure is required. Unfortunately, WMARSS could not provide this information for all five of the major lift stations it operates. As a result of this limitation, four of the five lift stations were modeled using a fixed pump capacity. **Given that the WMARSS interceptor system is a limiting factor in the performance of the City of Waco collection system, this should be viewed as a significant limitation in the performance of the hydraulic model.**

An additional issue with the WMARSS lift stations is associated with the Woodway lift station. This station pumps wastewater to a control valve system that can divert flows to either the City of Waco system or the WMARSS interceptor system. There is little information available regarding the control procedure.

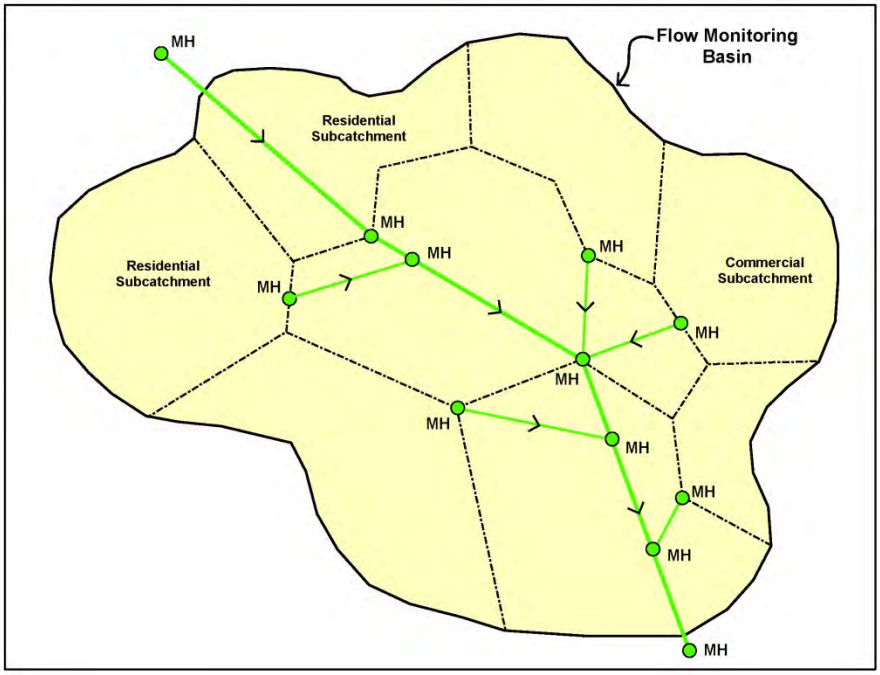
5.2.4 Wastewater Flow Allocation

One of the more complex tasks in building a wastewater hydraulic model is the allocation of wastewater among the pipelines and manholes represented in the model. **The allocation is typically based on population density and distribution. A typical wastewater diurnal curve is used to alternate the wastewater flow rates over time.** Temporary wastewater flow monitoring data is used to determine the rate at which wastewater is introduced into the system.

Subcatchments group homogeneous wastewater generators into larger aggregate groups that can then be loaded into the model.

The initial step in developing wastewater flow allocations is to determine where wastewater generated by groups system users enters the collection system. These entry points are bounded by areas called subcatchments. A typical residential subcatchment encompasses the area served by a single wastewater main. The goal of developing subcatchments is to group homogeneous wastewater generators into larger aggregate groups and then load that wastewater into a model mode. Subcatchments can also be defined using land use maps, zoning maps, traffic analysis zones, and other information in order to develop the areas for wastewater generation. Subcatchments are aggregated into flow meter basins, such that the data from temporary wastewater flow monitoring exercise can be used to aid in the development of volumes and rates of wastewater generated. Typical subcatchments are illustrated in Figure 5-2:

Figure 5-2: Typical Subcatchments



The entire City of Waco wastewater service area is represented in the model, even though pipelines smaller than 12-inch in diameter are not included in the model. This is accomplished through the application of subcatchments representing those areas that generate wastewater but are not served by a modeled pipe.

In several instances, subcatchments were further subdivided into smaller areas in order to develop more control over how and when wastewater would be injected into the modeled collection system. This practice is typical in the wastewater modeling industry and is usually applied when complex system connectivity issues exist, as is the case in portions of the Barron's Branch drainage basin. As previously discussed, one of the goals of developing subcatchments is to create homogeneous areas of wastewater generators. Therefore, different subcatchments are created for residential, commercial, and industrial generators. As the subcatchments are defined for the various wastewater generators, the next step becomes distribution of populations among the subcatchments.

Population distributions for both existing and future populations are accomplished by intersecting the Traffic Analysis Zones (TAZ) described in Chapter 3 of this document with the subcatchments that have been created for the model. The populations are assigned based on a weighted distribution based on the areas of the TAZ and the subcatchment.

Table 3-10: Large Wastewater Customers

Company Name	1,000 gallons/month
Cargill Meat Solutions Corporation	24,686
Coca Cola	21,995
Pilgrim's Pride	19,083
Mars	11,044
Hillcrest Baptist Medical Center	6,074
Allergan, Inc.	4,961
VA Medical Center	4,414
Providence Health Center	4,213
Owens-Illinois	3,547
Alcoa Fastening Systems	3,242
Oak Farms Dairy	3,181
H&B Packing Company, Inc.	1,988
Packaging Corporation of America	1,485
L-3 Communication (Alodine)	1,270
Central Tx Corrugated	958
Precise Hard Chrome (Joy Drive)	696
Marathon	534
Precision National Plating Services, Inc.	447
Packless Industries	427
Caterpillar Work Tools, Inc.	262
Time Manufacturing Company	179
Hobbs Bonded Fibers	142
Tymco Inc.	93
Precise Hard Chrome (Plant)	91
Waco Metal Finishing	76
Mercury Tool	23
L-3 Communication (Batch)	18

Table 3-10: Large Wastewater Customers (Page 3-25)

Large generators of wastewater (typically industrial generators) are loaded as "trade waste" in the model. Each trade waste generator is assigned its own diurnal curve and wastewater volume. This information is developed to closely represent the particular generator's operations. For example, if a large trade waste generator only released wastewater between the hours of 3:00 p.m. and 10:00 p.m. on alternate Tuesdays, a diurnal curve was created and assigned to that generator. The flow is injected into the model at the point (subcatchment) where the trade waste generator is physically located in the collection system. **A total of 13 of these trade waste generators are represented in the model.** These generators and their monthly contributions are shown in Table 3-10 (Page 3-25). Other significant generators of wastewater were also added to the model. In particular, **the Mt. Carmel Water Treatment Plant generates a constant wastewater stream of approximately 260 gallons per minute from filter backwash operations**. These flows are loaded into the system in the same manner as the trade waste generators.

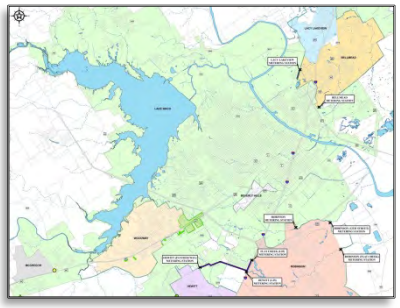


Figure 2-1: System Interconnection Map (Page 2-17)

Wastewater generated by the other WMARSS member cities and transported by the WMARSS interceptor system were included in the model as these wastewater flows significantly impact the performance of the City of Waco system. **Wastewater flow metering data from the nine WMARSS permanent flow monitoring sites was utilized to develop wastewater flow contributions from these entities.** Figure 2-1 (Page 2-17) shows the locations of these meter stations and Table 2-2 (Page 2-14) shows the average daily wastewater flow contributed to the WMARSS interceptor system at key locations.

In summary, wastewater flow allocation is accomplished through the application of small homogenous areas (subcatchments) which are used in combination with appropriately distributed wastewater generators (population) which are segmented by various

classifications (residential, commercial, industrial, etc.). Major wastewater generators are individually identified and loaded into the model. Wastewater flow generated by the WMARSS member cities was developed using data from permanent metering stations.

5.3 Hydraulic Model Calibration

In order to calibrate a hydraulic model, various parameters in the model are adjusted until the results from the model simulations closely match the data that represent real world conditions. In the case of the Waco Wastewater Master Planning model, the model is calibrated to match wastewater flow meter data from 26 temporary flow monitoring sites (see Chapter 4) and 9 permanent WMARSS flow monitoring sites. Model calibrations are typically completed for both dry and wet weather flow conditions.

5.3.1 Dry Weather Flow Calibration

Dry weather performance was best represented during the May 1, 2014 to May 8, 2014 time period.

Dry weather model calibration is a process by which certain parameters in the model are adjusted until the model output closely represents the actual system performance in terms of wastewater flow rates, peaks, valleys, and volume as recorded by the temporary flow monitors. **In order to represent a dry weather period, the temporary wastewater flow data is examined to locate a period (typically 5 – 10 days) of recorded flow data where the wastewater flow is not impacted by rainfall.** An examination of the recorded flow data revealed that the time period from May 1, 2014 to May 8, 2014 best represented dry weather system performance in the City of Waco system. This period was considered most desirable since it covered both weekdays and weekends and did not show any reaction to rainfall events in the collection system.

Dry weather wastewater flow data was normalized for each basin to create an hourly diurnal curve to represent expected wastewater flow parameters in each flow metering basin. These diurnals were applied to each subcatchment in order to generate wastewater in the model based on the population in that subcatchment. Various diurnal curves were created to match the population classification in the subcatchments (residential, commercial, etc.). The combination of the diurnals with subcatchment populations is used to generate wastewater in the model software. Winter average (WA) water use records were used to determine the number of gallons per capita per day (GPCD) of wastewater produced by the populations in the subcatchments. These values were adjusted as a function of the dry weather calibration process. Initial and final GPCD WA values are presented in Table 5-2. A lower GPCD value (initial vs. final) represents the scenario where less wastewater is generated (returned to the collection system) than is being used by the customer based on water billing.

Table 5-2: Final Metershed GPCD

Meter Basin	Winter Ave GPCD (based on water use)		Model Calibrated GPCD (based on meters)	
	Residential	Commercial	Residential	Commercial
BB01	53	48	50	50
BB02	55	68	50	65
BB03	106	33	45	35
BB04	51	67	50	65
TB0A*2	63	39	60	40
BZ01	49	54	45	50
BZ02	48	84	45	80
BZ03	51	90	30	40
BZ04	61	67	50	65
BZ05	53	28	50	30
BZ06	71	43	65	50
CW04	43	39	45	40
CW05*1	0	0	0	0
CW06	49	95	35	45
CW07	85	29	80	30
CW08	89	37	55	30
FC02#1	79	40	60	40
MK01	61	45	60	45
MK04	57	69	45	30
MK05	71	57	65	60
PR01	69	47	65	45
PR02	55	93	55	90
TB01	99	21	90	20
TB02	124	236	90	200
VL01#2	69	75	50	70

*1 – Runs through CW04 with no known connections
*2 – TB0A (Tinkers Branch) meter from B&N 2010 study
#1 – A GPCD of 100 was estimated for Speegleville based on pump run times
#2 – A GPCD of 55 was estimated for Village Lake based on pump run times
#3 – A GPCD of 180 was estimated for McLennan Co Jail based on pump run times
#4 – A GPCD of 100 was estimated for TSTC based on pump run times

Constant infiltration into the wastewater collection system is represented as base flow or dry weather infiltration. Base flow is common in wastewater collection systems. Base flow was determined by subtracting the calculated wastewater flow from the

GPCD WA computations from the wastewater flow recorded by the wastewater flow data for dry weather. This portion of the overall wastewater flow is distributed across the entire meter basin.

As the model is calibrated, certain parameters are adjusted in an interactive process. For the City of Waco model, diurnal profiles, base infiltration values, daily flow per capita (GPCD), and transient population (Baylor students) inputs were varied. The model was calibrated to match the wastewater flow regime recorded by the temporary wastewater flow meters for the period of May 1 to May 8, 2014. A summary of the dry weather model calibration is presented in Table 5-3.

Table 5-3: Dry Weather Model Calibration Summary

Flow Meter	Dry Weather Flow				Difference in Peak Flow (%)	Difference in Volume (%)
	Observed Meter Data		Model Predicted Results			
	Average Peak Flow (MGD)	Volume (MG)	Peak Flow (MGD)	Volume (MG)		
TB0A	0.64	0.38	0.69	0.42	7%	10%
BB01	2.47	1.90	2.55	2.08	3%	9%
BB02	1.64	0.67	1.21	0.74	-35%	10%
BB03	0.30	0.13	0.23	0.13	-31%	-6%
BB04	1.06	0.66	1.00	0.73	-5%	10%
BZ01	8.74	6.85	8.40	6.50	-4%	-5%
BZ02	1.39	0.78	0.94	0.72	-48%	-8%
BZ03	0.33	0.16	0.27	0.19	-20%	13%
BZ04	0.80	0.47	0.77	0.49	-4%	3%
BZ05	2.28	1.63	2.47	1.78	8%	9%
BZ06	0.71	0.52	0.79	0.57	10%	9%
CW04	0.59	0.28	0.48	0.31	-23%	11%
CW05	1.71	1.33	1.78	1.31	4%	-1%
CW06	4.10	1.20	4.91	1.22	16%	1%
CW07	1.73	1.16	1.77	1.30	2%	11%
CW08	0.59	0.42	0.62	0.47	5%	11%
FC02	2.36	1.62	2.57	1.79	8%	10%
MK01	0.30	0.18	0.19	0.17	-60%	-8%
MK04	0.75	0.31	0.53	0.33	-40%	6%
MK05	0.14	0.08	0.09	0.07	-47%	-15%
OF01	0.85	0.51	0.80	0.56	-6%	10%
PR01	1.36	0.90	1.48	0.96	8%	6%

PR02	0.69	0.43	0.78	0.46	12%	5%
TB01	1.28	0.93	1.54	1.01	17%	7%
TB02	1.14	0.62	2.10	0.56	46%	-11%
VL01	0.81	0.39	0.80	0.44	-1%	11%

5.3.2 Wet Weather Flow Calibration

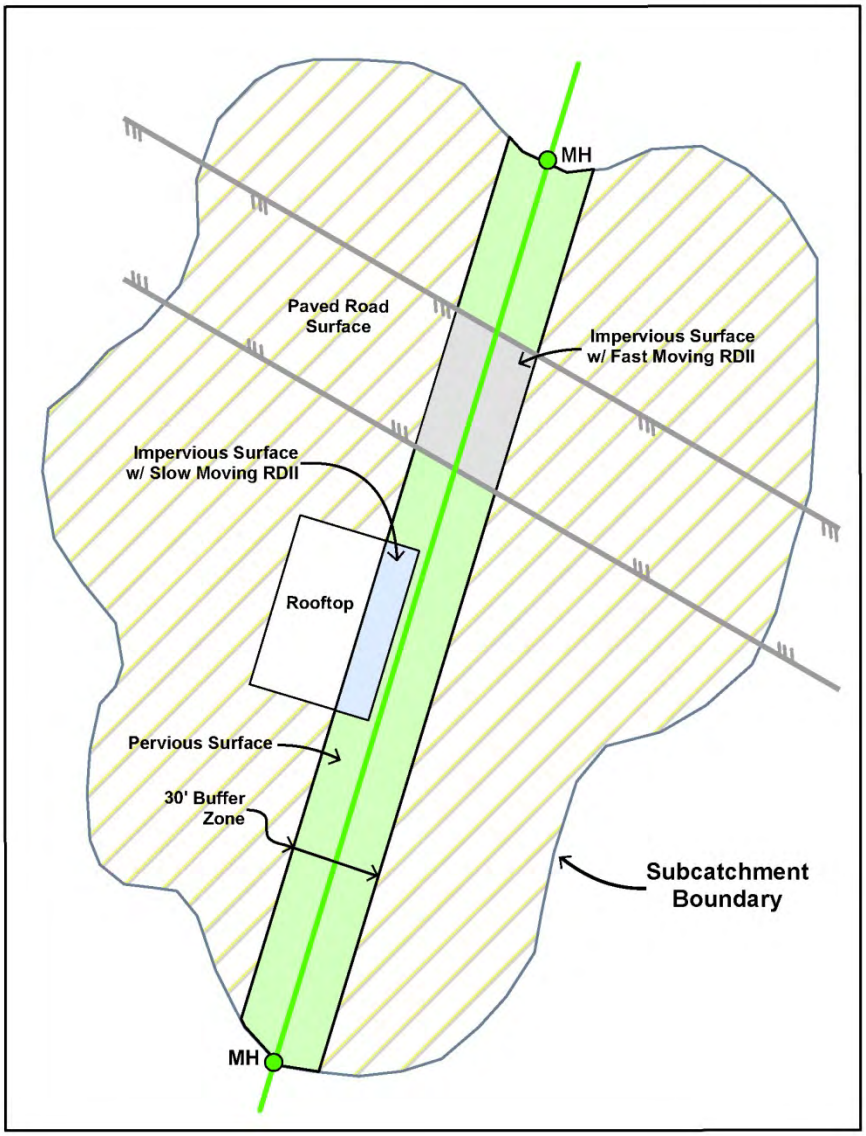
Wet weather calibration represents the collection system's performance under wet weather conditions in the model.

Wet weather calibration of the hydraulic model is based on the results of the dry weather calibration and is intended to represent the collection system's performance under wet weather conditions in the model. During the calibration process, certain parameters in the model are adjusted in an iterative process in order to represent the amount of rainfall that enters the collection system. This is a somewhat more complex undertaking than the dry weather calibration process. **There are a number of ways rainfall can enter a collection system. The most common are direct inflow (such as a storm sewer connection to the sanitary system) and infiltration (such as water percolating through the ground and entering through cracks in pipes).** The rate at which the rainfall enters the collection system further complicates the calibration process. In order to manage the complexities of modeling this physical phenomenon, typically referred to as Rainfall Dependent Inflow and Infiltration (RDII), the modeling software requires the use of "runoff surfaces." These surfaces are created in much the same way as the subcatchments for wastewater generation are created. In fact, the wastewater subcatchments are further divided into runoff surfaces for the following classifications of runoff:

- Impervious surfaces with fast moving RDII, such as roads.
- Impervious surfaces with slow moving RDII, such as parking lots and rooftops.
- Pervious areas such as unpaved grassy or gravel areas.

When considering the physical process of rain falling over a sanitary sewer basin, it is a consideration of the modeling process to determine the physical area contributing to RDII generation. For example, the area at the top of a hill is less likely to contribute to RDII than points below it. There are a number of supporting examples. It is generally concluded that not all of the sewered area in the model contributes. Therefore, it is standard practice to limit these areas to areas close to the gravity sanitary sewer pipes. For the City of Waco model, all gravity sewer mains were buffered by 30' using the City's GIS and that area was used to determine the area for RDII contribution. Once this contributing area was developed, it was subdivided into RDII zones for the various types of RDII, based on the wastewater generating subcatchments. Figure 5-3 represents the process.

Figure 5-3: RDII Contributing Area Example



For each runoff surface in each basin, the variables for calibration included:

- Runoff routing value - Similar to a time of concentration for determining how long it takes for the flow to get into the system.
- Runoff coefficient for impervious surfaces - This is effectively a percentage of the rainfall that lands on this area that will enter the system.
- Soil depth for pervious surfaces - This is used to define how wet the catchment can become.
- Contributing area split between the three runoff surface areas.

Wet weather performance was calibrated using the data collected for the storm event on May 12, 2014.

For impervious areas, the runoff coefficient and contributing sub-areas determine the volume of RDII. The soil depth and associated

contributing area create a storage that is used to determine the volume of RDII. As the catchment gets wetter, more volume is generated from the pervious surface. The soil storage is emptied or dried out at the rate defined by evaporation for the rainfall event. This allows for a continual simulation for all the rainfall data for a calibration run. To approximate the RDII, the model was calibrated for wet weather flow using the data collected for the storm event on May 12, 2014. The associated summary is shown in Table 5-4.

Table 5.4: Wet Weather Flow Calibration

Flow Meter	Wet Weather Flow Calibration May 12 2014 (5/12 18:00 to 5/22 12:00)						Difference in Peak Flow (%)	Difference in Volume (%)
	Observed Rainfall		Observed Meter Data		Model Predicted Results			
	Total Storm Depth (in)	Peak Intensity (in/hr)	Peak Flow (MGD)	Volume (MG)	Peak Flow (MGD)	Volume (MG)		
TB0A	3.63	3.72	1.78	0.84	1.94	0.81	**8%**	**-3%**
BB01	2.77	2.64	6.94	3.14	7.59	2.62	**9%**	**-20%**
BB02	3.75	3.84	7.57	1.04	6.46	1.23	**-17%**	**15%**
BB03	3.75	3.84	2.08	0.45	1.66	0.42	**-25%**	**-7%**
BB04	2.77	2.64	6.72	0.81	5.04	0.87	**-33%**	**7%**
BZ01	2.80	3.00	27.37	9.32	24.47	8.24	**-12%**	**-13%**
BZ02	2.74	3.60	3.13	0.76	2.49	0.77	**-26%**	**2%**
BZ03	2.74	3.60	1.69	0.17	1.81	0.21	**7%**	**17%**
BZ04	3.87	4.08	3.80	0.73	3.68	0.69	**-3%**	**-7%**
BZ05	3.87	4.08	13.11	2.89	14.15	2.79	**7%**	**-3%**
BZ06	3.87	4.08	5.12	1.13	5.05	0.97	**-1%**	**-16%**
CW04	2.74	3.60	4.35	0.42	3.83	0.39	**-14%**	**-8%**
CW05	2.74	3.60	9.25	2.21	8.75	2.22	**-6%**	**1%**
CW06	3.21	3.84	9.02	4.14	8.94	3.89	**-1%**	**-7%**
CW07	3.87	4.08	8.15	2.12	8.41	2.20	**3%**	**4%**
CW08	3.87	4.08	2.34	0.76	2.24	0.75	**-5%**	**-1%**
FC02	3.83	3.84	6.32	2.34	5.20	2.35	**-21%**	**0%**
MK01	2.80	3.00	1.60	0.25	1.64	0.21	**2%**	**-16%**
MK04	2.80	3.00	2.70	0.37	1.88	0.37	**-44%**	**1%**
MK05	2.80	3.00	0.80	0.09	0.78	0.08	**-3%**	**-9%**
OF01	3.75	3.84	3.43	0.57	2.95	0.67	**-16%**	**14%**
PR01	2.74	3.60	7.21	1.09	6.87	1.17	**-5%**	**7%**
PR02	2.74	3.60	4.52	0.53	3.22	0.57	**-40%**	**7%**
TB01	3.99	5.28	5.20	1.57	5.35	1.51	**3%**	**-4%**
TB02	3.99	5.28	5.89	0.92	3.77	0.81	**-56%**	**-13%**
VL01	2.89	3.72	5.50	0.53	5.42	0.57	**-1%**	**6%**

It is common practice to calibrate a model to two rainfall events and then verify against one another. However, only one rain event considered adequate for calibration purposes was recorded during the flow monitoring period. The other events are either too close to the calibration event, were not of sufficient total rainfall depth or intensity, or were not wide spread enough over the city to be considered appropriate for calibration purposes.

Therefore, it was decided that the model would be run for the entire period of temporary flow meter data for verification of the model. The results for the rainfall events on April 6 and May 8 are shown in Tables 5-5 and 5-6. The May 8 event is large enough to use for calibration, but its proximity to the calibration event of May 12 makes it less suitable for calibration and better suited to verification since it has a great effect on the catchment wetness for the calibration event.

Table 5-5: Wet Weather Flow Verification April 6, 2014

Flow Meter	Wet Weather Flow Verification April 6 2014 (4/6 7:45 to 4/6 14:00)						Difference in Peak Flow (%)	Difference in Volume (%)
	Observed Rainfall		Observed Meter Data		Model Predicted Results			
	Total Storm Depth (in)	Peak Intensity (in/hr)	Peak Flow (MGD)	Volume (MG)	Peak Flow (MGD)	Volume (MG)		
TB0A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**	**N/A**
BB01	0.72	1.44	2.97	2.26	3.81	2.65	**22%**	**15%**
BB02	0.70	1.98	1.86	0.97	1.84	1.09	**-1%**	**11%**
BB03	0.70	1.98	0.47	0.37	0.35	0.28	**-35%**	**-34%**
BB04	0.72	1.44	1.35	0.92	2.30	1.15	**41%**	**20%**
BZ01	0.66	0.96	11.75	8.65	13.10	8.82	**10%**	**2%**
BZ02	0.86	3.12	1.43	0.94	1.52	0.93	**6%**	**-1%**
BZ03	0.86	3.12	0.30	0.19	0.78	0.30	**61%**	**36%**
BZ04	0.85	2.28	1.51	0.80	1.93	0.77	**22%**	**-4%**
BZ05	0.85	2.28	3.83	2.58	5.84	2.94	**35%**	**12%**
BZ06	0.85	2.28	1.36	0.96	1.99	1.10	**32%**	**12%**
CW04	0.86	3.12	1.28	0.42	2.74	0.50	**53%**	**16%**
CW05	0.86	3.12	3.96	2.15	5.40	2.15	**27%**	**0%**
CW06	0.97	3.24	N/A	N/A	6.47	3.57	**N/A**	**N/A**
CW07	0.97	3.24	4.06	2.07	5.39	2.16	**25%**	**4%**
CW08	0.85	2.28	1.09	0.67	0.96	0.76	**-13%**	**12%**
FC02	0.40	1.56	3.15	2.14	3.63	2.43	**13%**	**12%**
MK01	0.66	0.96	0.35	0.22	0.52	0.23	**33%**	**2%**
MK04	0.66	0.96	0.67	0.38	0.58	0.42	**-17%**	**9%**
MK05	0.66	0.96	0.17	0.11	0.28	0.11	**40%**	**1%**

OF01	0.70	1.98	1.32	0.79	1.81	0.91	**27%**	**13%**
PR01	0.86	3.12	2.56	1.40	4.51	1.60	**43%**	**12%**
PR02	0.86	3.12	1.39	0.74	2.93	0.86	**52%**	**14%**
TB01	0.85	2.88	1.96	1.42	3.03	1.31	**35%**	**-9%**
TB02	0.85	2.88	1.85	0.90	2.82	0.80	**35%**	**-12%**
VL01	0.37	1.68	1.08	0.57	1.72	0.64	**37%**	**11%**

Table 5-6: Wet Weather Flow Verification May 8, 2014

Flow Meter	Wet Weather Flow Verification May 8 2014 (5/8 10:45 to 5/8 19:45)						Difference in Peak Flow (%)	Difference in Volume (%)
	Observed Rainfall		Observed Meter Data		Model Predicted Results			
	Total Storm Depth (in)	Peak Intensity (in/hr)	Peak Flow (MGD)	Volume (MG)	Peak Flow (MGD)	Volume (MG)		
TB0A	N/A	N/A	N/A	N/A	N/A	N/A	**N/A**	**N/A**
BB01	1.79	3.00	2.99	1.85	5.58	2.79	**46%**	**34%**
BB02	1.86	3.30	2.48	0.83	3.36	1.27	**26%**	**35%**
BB03	1.86	3.30	0.46	0.18	0.97	0.39	**53%**	**53%**
BB04	1.79	3.00	2.67	0.80	3.55	1.06	**25%**	**25%**
BZ01	1.78	3.00	18.20	9.07	18.91	9.71	**4%**	**7%**
BZ02	2.33	3.60	3.42	1.08	1.85	0.90	**-85%**	**-20%**
BZ03	2.33	3.60	0.88	0.21	1.06	0.28	**16%**	**27%**
BZ04	1.86	3.36	2.38	0.66	2.89	0.89	**17%**	**26%**
BZ05	1.86	3.36	8.01	2.71	10.53	3.71	**24%**	**27%**
BZ06	1.86	3.36	2.49	0.94	3.59	1.44	**31%**	**35%**
CW04	2.33	3.60	3.48	0.54	3.74	0.55	**7%**	**0%**
CW05	2.33	3.60	7.36	2.26	7.18	2.64	**-2%**	**15%**
CW06	2.26	3.96	7.32	4.35	7.45	3.85	**2%**	**-13%**
CW07	1.86	3.36	7.39	2.22	7.17	2.62	**-3%**	**15%**
CW08	1.86	3.36	2.11	0.65	1.76	0.97	**-20%**	**33%**
FC02	2.47	4.08	4.12	2.22	5.03	2.62	**18%**	**15%**
MK01	1.78	3.00	1.09	0.28	1.14	0.27	**4%**	**-4%**
MK04	1.78	3.00	1.38	0.60	0.82	0.38	**-68%**	**-57%**
MK05	1.78	3.00	0.37	0.11	0.43	0.10	**15%**	**-4%**
OF01	1.86	3.30	2.15	0.65	2.66	0.83	**19%**	**21%**
PR01	1.80	3.60	4.05	1.23	5.08	1.62	**20%**	**24%**
PR02	1.80	3.60	2.39	0.61	3.00	0.83	**20%**	**26%**
TB01	2.26	4.80	2.45	1.21	4.06	1.59	**40%**	**24%**
TB02	2.26	4.80	1.32	0.76	3.13	0.95	**58%**	**20%**
VL01	1.29	3.12	2.91	0.77	3.36	0.74	**13%**	**-4%**

5.4 EXISTING SYSTEM HYDRAULIC MODEL ANALYSIS

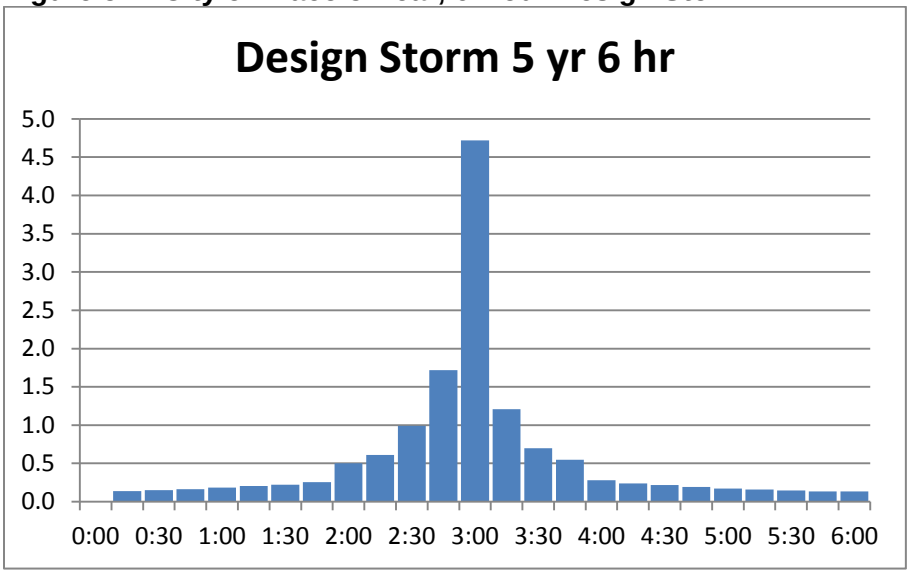
5.4.1 Design Criteria and Model Assumptions

Most municipalities in the Texas regions utilize a 5-year, 6-hour design storm for capacity analysis.

The design storm is a key element driving the development of system capacity improvement recommendations. Within the United States, there is no single method that has consensus within the industry as to the application of one uniform design storm event. In general, design storms are developed based on regionally accepted durations and frequencies. Most municipalities in the Texas regions utilize a 5-year, 6-hour design storm for capacity analysis. **After corroborative discussion and deliberation, the City and the Project Team agreed that the 5-year, 6-hour storm event should be chosen to evaluate the City's collection system.** Storm events are classified by intensity and duration. Based on historical data, frequency contour maps for given intensity and duration storm events have been developed by the United States Geological Survey (USGS) for the State of Texas. USGS classifies a 5-year, 6-hour storm event in Waco as 3.5 inches. **This means that in any given year, there is a 20% chance that 3.5 inches of rain will fall in any 6-hour period.**

With the model calibrated for both dry and wet weather events, it was ready to be used to evaluate the system. Hydraulic analysis requires flow inputs and performance criteria. The first step in this process was to choose a design storm and set the allowable levels of performance criteria. A 5-year return interval and 6-hour duration storm was chosen as the design storm to evaluate the modeled system performance. This is in keeping with the 'de-facto standards of the day' since this is what most large cities typically use for analysis within the State of Texas and nationally. The design storm was developed using the USGS Precipitation Atlas Depth Duration data published in 2004. The profile used for the analysis is shown in Figure 5-4.

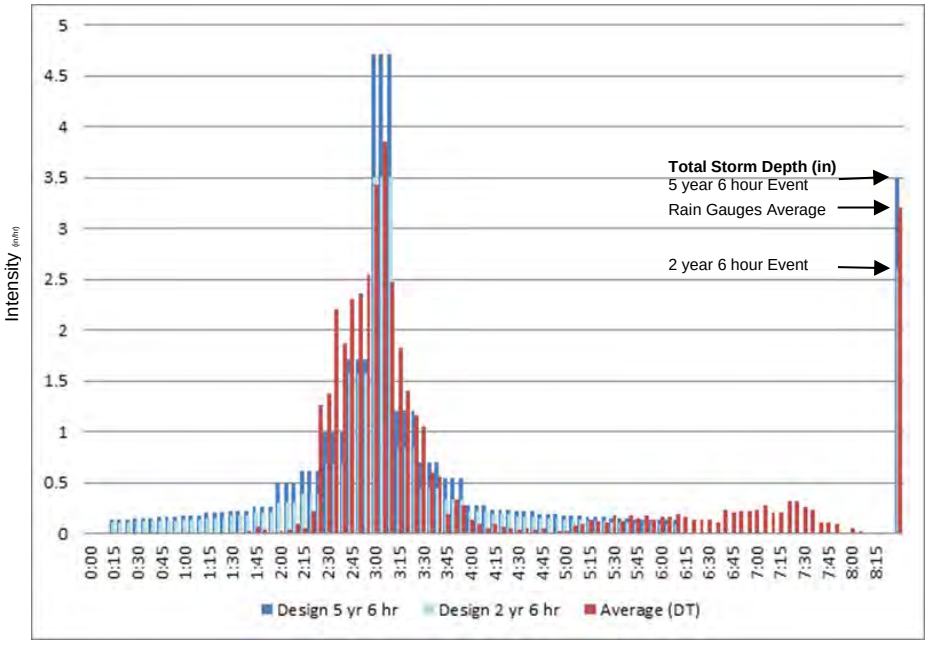
Figure 5-4: City of Waco 5-Year, 6-Hour Design Storm

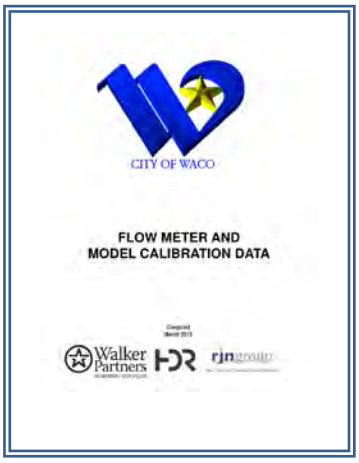


The calibrated model was run for dry weather conditions, a 2-year, 6-hour event and a 5-year, 6-hour event. It is interesting to compare the design storm event with the temporary monitoring rain gauges. The closer these events match, the better the calibrated model can be considered to be for the purpose of evaluating the system response to the design storm. It is typically found that a calibrated model will underestimate inflow and infiltration for a smaller rain event and overestimate for larger events than that of the available calibration events.

For example, if the calibration event is less than a 2-year event, then the results the model generates will likely be over predicting the storm contribution whereas if the calibration event was larger than a 10-year event then applying a 5-year design storm would likely under predict the RDII contribution. This is largely due to the modeled processes that simulate how rainwater enters the collection system. **Inflow tends to respond quickly to smaller events and slows down as the events increase in magnitude because the routes that water follows to get into the system get wet and start restricting the rate.** The comparison shown in Figure 5-5 shows the averaged rain gauges for the central part of the city overlaid with the 2-year and the 5-year, 6 hour events.

Figure 5-5: Design Storm vs Average of Rain Gauges for Calibration Event





The averaged temporary rain gauge data lies between the 2-year and 5-year, 6-hour events. **The recorded peak intensity is closer to the 2-year event with the total rainfall depth closer to the 5-year event.** A plot for each of the temporary monitoring rain gauges is supplied in the Flow Meter and Model Calibration Data notebook. From these plots it can be seen that the Twin Bridges (RG08)

Sanitary Sewer Basin (SSB) received slightly more rainfall than a 5-year, 6-hour event. The upstream ends of the Barrons Branch, Brazos, Bosque, Cottonwood and Carver SSBs (rain gauges 4, 5 and 6) received approximately the 5-year, 6-hour rainfall depth but the peak intensity was slightly less. **The calibration rainfall event is therefore considered to be a good event for developing a model to apply the 5-year, 6-hour design storm for analysis.**

The goal of the hydraulic modeling of the existing collection system was to analyze the system response to locate capacity deficiencies and potential problem areas that are in need of improvements. The system performance during the design storm was evaluated using the following criteria:

1. Location and quantity of sanitary sewer overflows.
2. Pipes surcharged to within two feet of a manhole rim elevation.
3. Pipes surcharged due to being under capacity for the flow.
4. Pipes surcharged due to a downstream restriction or other condition.
5. Pipes that are over 80% full.

The 5-year, 6-hour event is the design storm for the model. The existing system model was run with a 2-year and a 5-year set of design storms to observe the model reaction and system sensitivity. The main goal of the modeling task was to determine areas of system deficiencies. The primary task was to make recommendations for system improvements to resolve all modeled capacity sanitary sewer overflow problems. Secondly, it was desirable to keep the hydraulic grade line (HGL) below two feet of the manhole rim elevations for areas that were prone to sanitary sewer overflows.

It was not necessary to keep the HGL below two feet of the rim elevation for all locations in the model. Not all areas are at equal risk of a sanitary sewer overflow under this criterion. For example, a 12-inch main with a smaller catchment area is less likely to overflow when the HGL is close to the rim than a 60-inch main that has a large catchment area and many lines feeding it. **The higher risk manholes were considered necessary to maintain the HGL below a two-foot depth from the manhole rim elevation.** All new proposed or improved sections were designed to be no more than 80% full during the design event.

All new proposed or improved sections were designed to be no more than 80% full during the design event.

The manhole rim elevations were determined from the City's surface elevation data (2 foot contours) and thus are dependent on the quality of the elevation data and the location of the GIS manhole asset. **Where a manhole was at or near a sanitary sewer overflow in the model, as-built drawing data were used and/or field surveying was conducted to ascertain the correct elevation to use for the model.** Some of the upper catchment area manholes may not have the actual rim elevation because the manhole did not show a risk of a sanitary sewer overflow.

5.4.2 Dry Weather System Analysis

Under dry weather conditions, the McLennan County Jail Lift Station is under capacity when assuming a full population of inmates. This condition has been corroborated by Water Utilities staff. Staff provided run time facts for this lift station which indicates that one pump runs virtually continuously with the lag pump additionally running at various times throughout the day.

The model shows a number of pipes within the City's collection system where the HGL is within two feet of the manhole rim elevation during dry weather conditions. These pipes and manholes are generally located in the upper portions of the City's collection system and generally not in an area prone sanitary sewer overflows according to Water Utilities staff. These conditions were considered acceptable for this analysis. These conditions may exist due to incorrect manhole rim elevations or are the result of model loading, and are believed to be of low risk of an overflow due to their location and history. All locations of pipes that fail one of the set criteria for the dry weather flow simulation are shown in Figure 5-6 and a summary of the data is shown in Table 5-7.

Area Upstream of Fort Fisher Park

Under dry weather conditions, a section of pipes upstream of manhole 703021 in Fort Fisher Park and across S. University Parks Drive are more than 80% full. The reason for this is that the pipes between manholes 703021 and 7030069 are believed to be at a reverse grade causing a backup to form in the line. The pipe between manholes 703005 and 703026 is shown as under capacity because it is essentially flat. This slope combined with the downstream restriction causes this pipe to surcharge.

5.4.3 2-Year Event

The 2-year, 24-hour design storm produces three sanitary sewer overflows in the collection system model simulation. Further, the collection system exhibits numerous locations where the model criteria is in danger of being exceeded. **The three sanitary sewer overflow locations are at the West Bank Interceptor (near BB01 temporary flow meter), near the Waco Regional Airport where the force main from the Village Lake Lift Station returns to gravity, and the gravity line located between the TSTC Lift Station and the connection to the WMARSS gravity line.** The temporary BB01 flow meter data indicated that a sanitary sewer overflow occurred during the May 12, 2014 rainfall calibration event in this area. All locations of pipes that fail one of the evaluation criteria for the 2-year, 24-hour design storm simulation are shown in Figure 5-7 and a summary of the data is shown in Table 5-7. Figure 5-7 provides a listing of areas identified in the model that are deemed to be capacity locations or bottleneck areas for the 2-year, 24-hour storm event.

The temporary BB01 flow meter data indicated that a sanitary sewer overflow occurred during the May 12, 2014 rainfall calibration event.

5.4.4 5-Year Event

The 5-year, 6-hour design storm produces nine sanitary sewer overflows in the collection system model simulation. Further, the collection system exhibits numerous locations where the model criteria is in danger of being exceeded. **The nine sanitary sewer overflow locations are along the West Bank Interceptor; near Bosque Blvd. and 6th St. in Barron's Branch Basin; on 24th St. at Waco Drive in the Brazos Basin; two in the MLK Basin with one upstream and one downstream of the TSTC Lift Station; near the Waco Regional Airport and along China Springs Road in the Carver Basin; upstream of the Church Road Lift Station; and upstream of the Village Lake Lift Station.** All locations of pipes that fail one of the set criteria for the 5-year 6-hour design storm simulation are shown in Figure 5-8 and a summary of the data is shown in Table 5-7. Figure 5-8 provides a listing of areas identified in the model that are deemed to be capacity locations or bottleneck areas for the 5-year, 6-hour storm event.

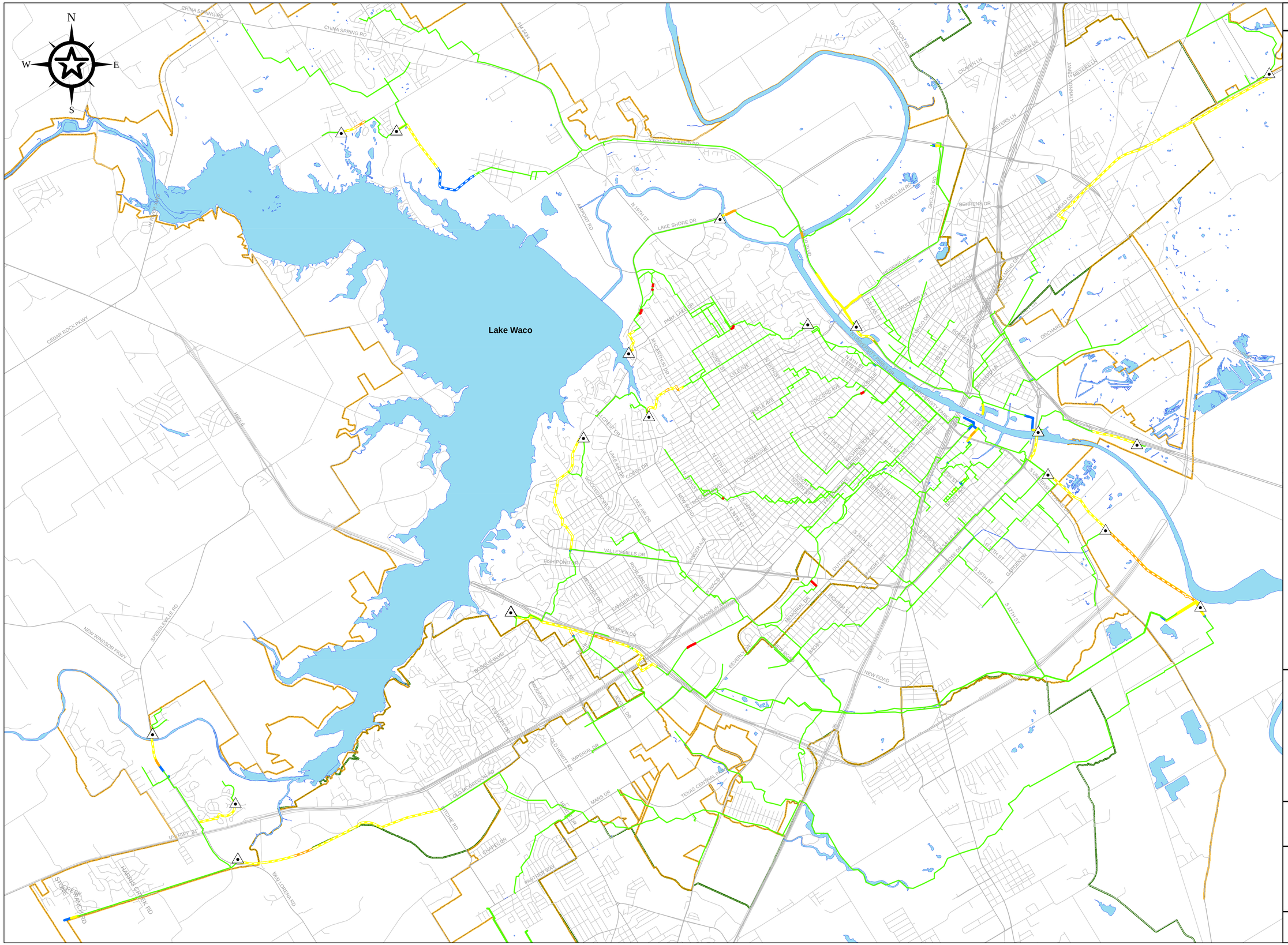
Table 5-7: Pipe Capacity Summary for Existing Conditions

	Number of SSO locations	HGL within 2 feet of RIM (feet)	Pipe under capacity for flow (feet)	Pipe full (feet)	Pipe is 80% to Full (feet)
City of Waco gravity lines					
Dry weather flow	0	2,927	1,598	3,739	3,879
2-year, 24-hour	3	16,538	50,003	77,947	36,435
5-year, 6-hour	9	25,590	65,726	109,299	43,106
All gravity lines in model - City of Waco and WMARSS					
Dry weather flow	N/A	7,015	17,377	126,620	9,958
2-year, 24-hour	N/A	21,814	86,471	235,070	49,803
5-year, 6-hour	N/A	34,759	111,152	276,320	48,412

5.4.5 Future Flow Scenarios

The existing service areas were updated with the projected population growth in the various growth areas as detailed in Chapter 3. **The future growth areas were connected to the system as shown in Figure 5-9 for flow loading to the model.** The projected growth areas are largely in the Carver, Village Lake and Speegleville Basins. The Speegleville Basin was additionally modeled as having its own future WWTP by removing the flows that are currently routed to the Church Road Lift Station.

THIS PAGE IS INTENTIONALLY LEFT BLANK



LEGEND

- Modeled Existing City of Waco / WMARSS Lift Station
- HGL < 2' from Manhole Rim
- Pipe Full (Q >= Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- <80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

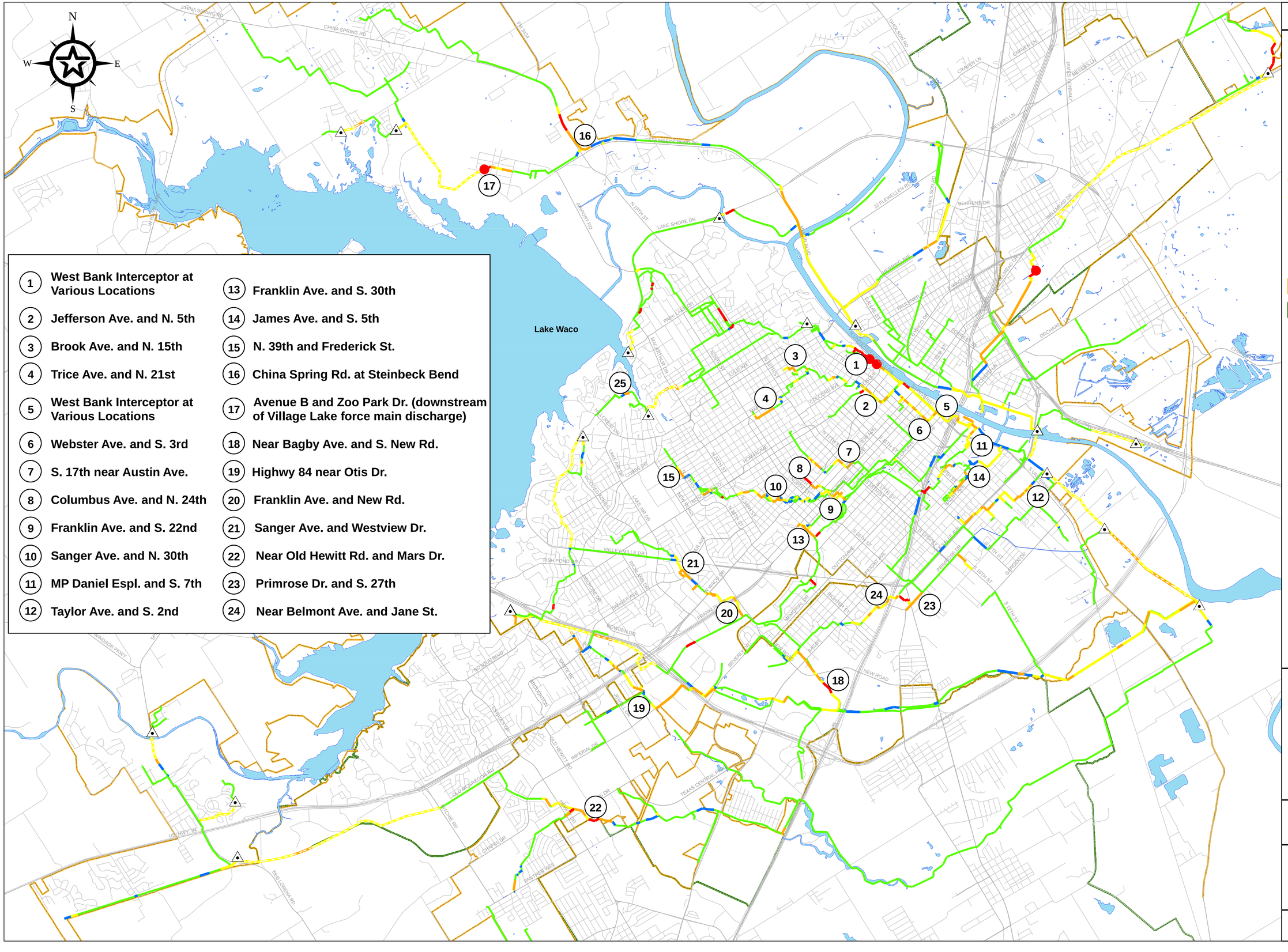
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-6: Existing 2014 System Peak Dry Weather Flow Model Results

G:\GIS\Projects\1-02231\Maps\Overall System Model Results.mxd



LEGEND

- Modeled Existing City of Waco / WMARSS Lift Station
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q >= Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- < 80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

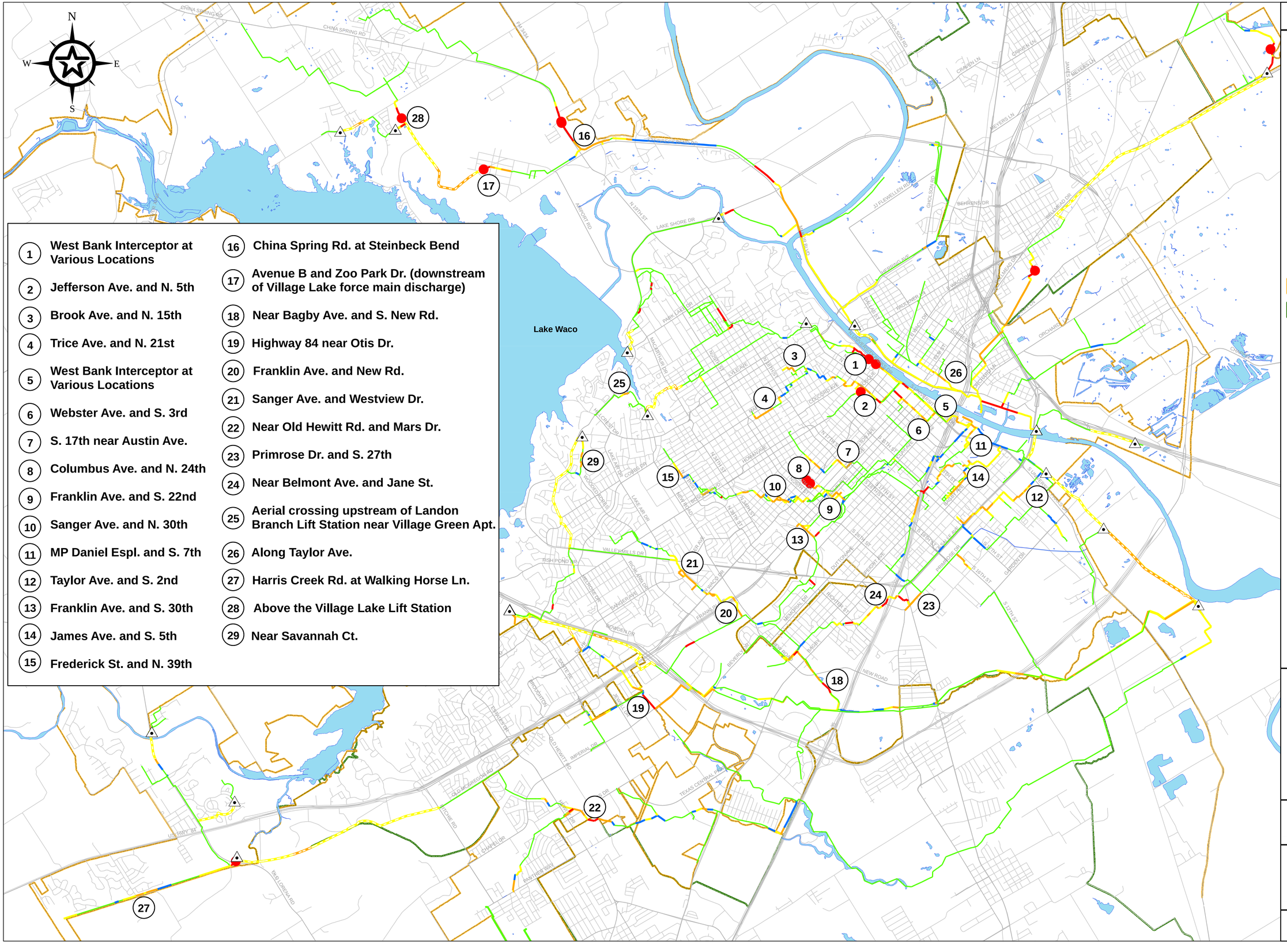
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-7: Existing 2014 System Capacity Issues During 2-Yr 24-Hr Storm Event

G:\GIS\Projects\1-02231\Maps\System Problem Areas.mxd



1. West Bank Interceptor at Various Locations
2. Jefferson Ave. and N. 5th
3. Brook Ave. and N. 15th
4. Trice Ave. and N. 21st
5. West Bank Interceptor at Various Locations
6. Webster Ave. and S. 3rd
7. S. 17th near Austin Ave.
8. Columbus Ave. and N. 24th
9. Franklin Ave. and S. 22nd
10. Sanger Ave. and N. 30th
11. MP Daniel Espl. and S. 7th
12. Taylor Ave. and S. 2nd
13. Franklin Ave. and S. 30th
14. James Ave. and S. 5th
15. Frederick St. and N. 39th
16. China Spring Rd. at Steinbeck Bend
17. Avenue B and Zoo Park Dr. (downstream of Village Lake force main discharge)
18. Near Bagby Ave. and S. New Rd.
19. Highway 84 near Otis Dr.
20. Franklin Ave. and New Rd.
21. Sanger Ave. and Westview Dr.
22. Near Old Hewitt Rd. and Mars Dr.
23. Primrose Dr. and S. 27th
24. Near Belmont Ave. and Jane St.
25. Aerial crossing upstream of Landon Branch Lift Station near Village Green Apt.
26. Along Taylor Ave.
27. Harris Creek Rd. at Walking Horse Ln.
28. Above the Village Lake Lift Station
29. Near Savannah Ct.

LEGEND

- Modeled Existing City of Waco / WMARSS Lift Station
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q => Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- <80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

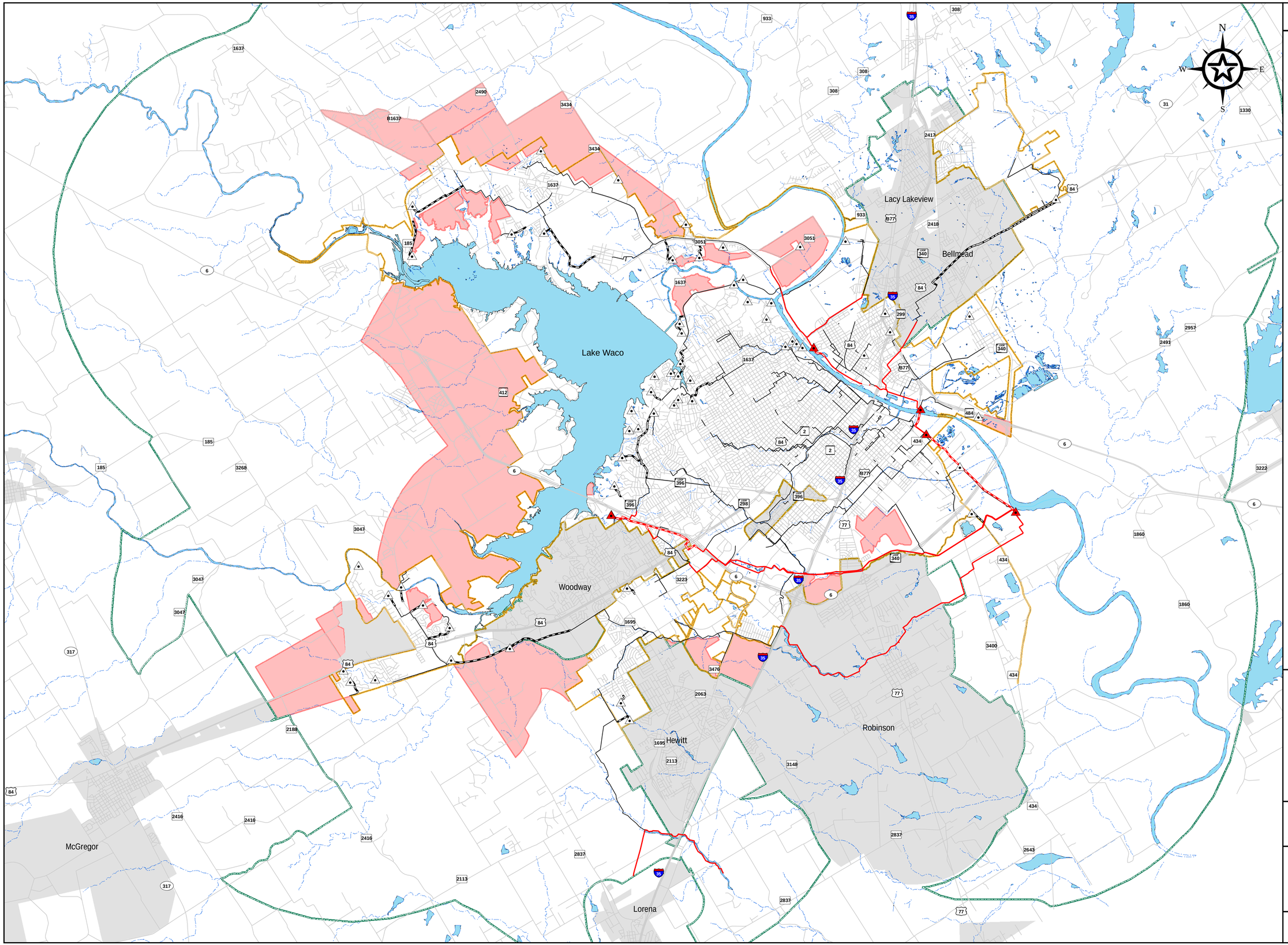
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-8: Existing 2014 System Capacity Issues During 5-Yr 6-Hr Storm Event

G:\GIS\Projects\1-02231\Maps\System Problem Areas.mxd



LEGEND

- Future Model Areas
- Ex. City of Waco Lift Station
- Ex. WMARSS Lift Station
- Existing City of Waco Gravity Sewer
- Existing City of Waco Force Main
- Existing WMARSS Gravity Sewer
- Existing WMARSS Force Main
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 2,500 5,000 10,000
Graphic Scale (Feet)

Figure 5-9: Future Model Extents

G:\GIS\Projects\1-02231\Maps\Future Growth Area Map.mxd

5.5 Future Wastewater System Analysis (No Improvements)

The Existing Conditions Calibrated Model was adjusted to include the projected 2040 population growth as outlined in Chapter 3. **The model simulation was run for dry weather conditions and a 5-year, 6-hour rainfall event.** Intermediate decades were not analyzed in the model because the relative population changes and resulting flow changes were not significant when compared to the volume of flows generated under the design storm conditions. In other words, the wet weather events control the system sizing and the 2040 wet weather response is the most conservative design condition. Therefore, this is the boundary condition for evaluating the system response. The summary of model results for the future system with no improvements is shown in Table 5-8.

5.5.1 Dry Weather

The model simulation produced two sanitary sewer overflows under dry weather flow conditions. These occurred at the McLennan County Jail Lift Station and the Church Road Lift Station. On the whole, the 2040 collection system does not show many more capacity issues than what the 2014 model simulation showed. The model results show the same pipe capacity issue due to adverse slope described in Section 5.4.2 to remain at Fort Fisher Park since it was not considered a risk area for overflows and therefore not planned to be replaced. These are shown in Figure 5-10. Those new areas in the model that meet the evaluation criteria under the future dry weather flows are predominately individual pipe segments with flows exceeding 80% full.

5.5.2 5-Year Event

The main model simulation 5-Year event areas of concern are located in the Carver, Village Lake and Speegleville Basins.

The same areas with capacity issues for the existing system show up under future 2040 loading as shown in Figure 5-11. The main areas of additional concern are located in the Carver, Village Lake, and Speegleville Sanitary Sewer Basins which have the projected areas of new growth. This projected growth and development will cause issues in the system for these areas, if not addressed through capacity improvements. The model produces 16 sanitary sewer overflow locations due to capacity issues. Additional future locations to those mentioned in the existing system analysis are in the Carver Basin (above the Brazos River siphon), the Speegleville Basin, and one in the Flat Creek Basin. Figure 5-11 provides a listing of areas identified in the model that are deemed to be capacity issue locations or bottleneck areas for the 5-year, 6-hour storm event.

THIS PAGE IS INTENTIONALLY LEFT BLANK

N

W E

S

Lake Waco

LEGEND

- Modeled Existing City of Waco / WMARSS Lift Station
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q >= Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- < 80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-10: Future 2040 System (No Improvements) Peak Dry Weather Flow Model Results

G:\GIS\Projects\1-02231\Maps\Overall System Model Results.mxd

N

W E

S

Lake Waco

1. West Bank Interceptor at Various Locations
2. Jefferson Ave. and N. 5th
3. Brook Ave. and N. 15th
4. Trice Ave. and N. 21st
5. West Bank Interceptor at Various Locations
6. Webster Ave. and S. 3rd
7. S. 17th near Austin Ave.
8. Columbus Ave. and N. 24th
9. Franklin Ave. and S. 22nd
10. Sanger Ave. and N. 30th
11. MP Daniel Espl. and S. 7th
12. Taylor Ave. and S. 2nd
13. Franklin Ave. and S. 30th
14. James Ave. and S. 5th
15. Frederick St. and N. 39th
16. China Spring Rd. at Steinbeck Bend
17. Avenue B and Zoo Park Dr. (downstream of Village Lake force main discharge)
18. Near Bagby Ave. and S. New Rd.
19. Highway 84 near Otis Dr.
20. Franklin Ave. and New Rd.
21. Sanger Ave. and Westview Dr.
22. Near Old Hewitt Rd. and Mars Dr.
23. Primrose Dr. and S. 27th
24. Near Belmont Ave. and Jane St.
25. Aerial crossing upstream of Landon Branch Lift Station near Village Green Apt.
26. Along Taylor Ave.
27. Harris Creek Rd. at Walking Horse Ln.
28. Above the Village Lake Lift Station
29. Near Savannah Ct.
30. Speegleville Rd. and Oak Rd.
31. Near Old China Spring Rd. at China Spring Rd.

LEGEND

- Modeled Existing City of Waco / WMARSS Lift Station
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q => Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- < 80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-11: Future 2040 System (No Improvements) Capacity Issues During 5-Yr 6-Hr Storm Event

G:\GIS\Projects\1-02231\Maps\System Problem Areas.mxd

Table 5-8: Pipe Capacity Summary for Future Conditions-No Improvements

	Number of SSO locations	HGL within 2 feet of RIM (feet)	Pipe under capacity for flow (feet)	Pipe full (feet)	Pipe is 80% to Full (feet)
City of Waco Gravity Lines					
Dry weather flow	2	4,848	4,009	10,045	7,111
5-year, 6-hour	16	36,235	89,599	130,117	39,357
All gravity lines in model - City of Waco and WMARSS					
Dry weather flow	N/A	9,759	19,801	141,305	8,625
5-year, 6-hour	N/A	47,391	135,891	296,403	45,693

5.6 Future Wastewater System Analysis (With Improvements)

The future 2040 wastewater system model simulation was run with the 1-10 year Capital Improvement Program improvements completed for both dry weather conditions and the 5-year, 6-hour design storm event. The primary goal was to analyze the system to determine if all of the sanitary sewer overflows in the City of Waco system were eliminated for the 5-year design storm event. The summary of model results for the future 2040 wastewater system with improvements is shown in Table 5-9.

5.6.1 Dry Weather

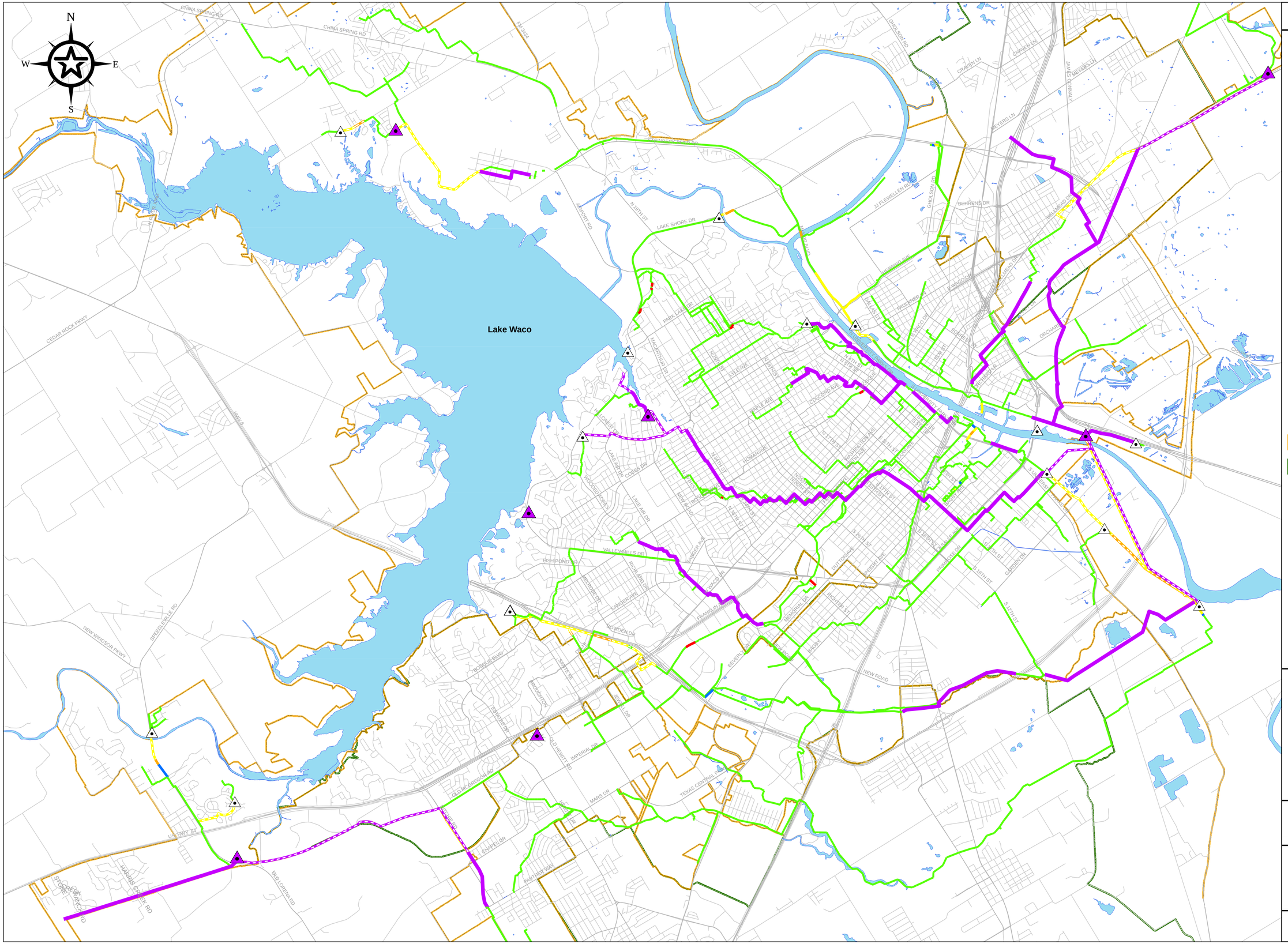
The model results in Figure 5-12 show the same pipe capacity issue due to adverse slope described in Section 5.4.2 to remain at Fort Fisher Park since it was not considered a risk area for overflows and therefore not planned to be replaced.

5.6.2 5-Year Event

With all the capital improvements as outlined in Chapter 8 applied to the system, the model simulation produced no sanitary sewer overflows. Therefore, all sanitary sewer overflows have been eliminated from the model results for the 5-year, 6-hour return interval design storm as shown in Figure 5-13. There are a few locations where the HGL rises to within 2 feet of the ground surface elevation. These locations deemed acceptable due to reasons of model accuracy outlined in Section 5.4.2. As described above, the ground surface elevation is not necessarily the rim elevation of the manhole, which could be raised.

Table 5-9: Pipe Capacity Summary for Future Conditions with Improvements

	Number of SSO locations	HGL within 2 feet of RIM (feet)	Pipe under capacity for flow (feet)	Pipe full (feet)	Pipe is 80% to Full (feet)
City of Waco gravity lines					
Dry weather flow	0	2,927	1,598	3,013	2,262
5-year, 6-hour	0	17,697	51,037	50,143	34,230
All gravity lines in model - City of Waco and WMARSS					
Dry weather flow	N/A	6,625	18,375	126,922	4,463
5-year, 6-hour	N/A	28,178	96,194	194,709	50,196



LEGEND

- Proposed / Upgraded City of Waco /WMARSS Lift Station
- Modeled Existing City of Waco / WMARSS Lift Station
- Proposed City of Waco / WMARSS Force Main
- Proposed / Rehabilitated City of Waco / WMARSS Gravity Sewer
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q >= Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- < 80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

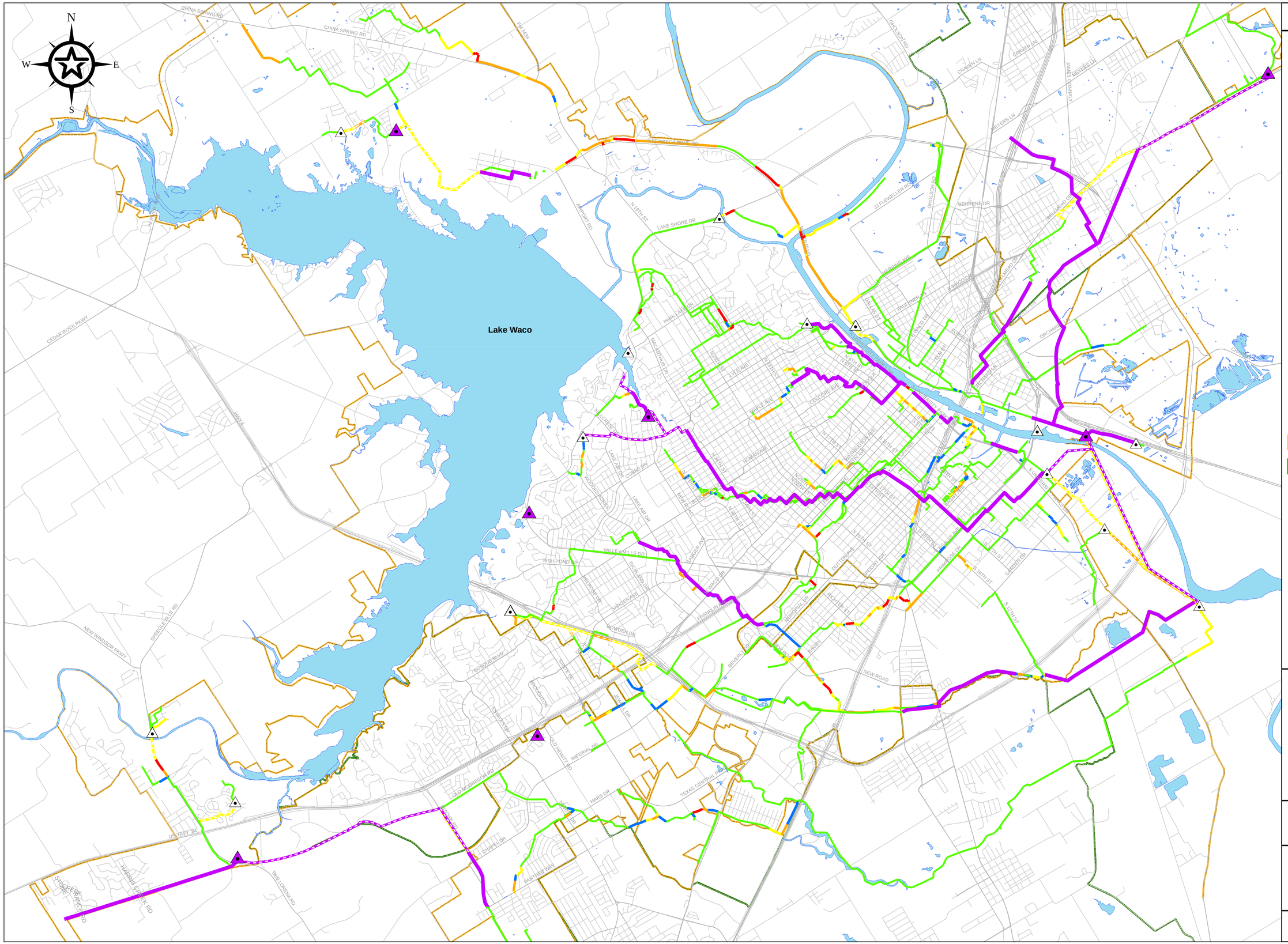
CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-13: Future 2040 System (With Improvements) Peak Dry Weather Flow Model Results

G:\GIS\Projects\1-02231\Maps\Overall System Model Results.mxd



LEGEND

- Proposed / Upgraded City of Waco /WMARSS Lift Station
- Modeled Existing City of Waco / WMARSS Lift Station
- Proposed City of Waco / WMARSS Force Main
- Proposed / Rehabilitated City of Waco / WMARSS Gravity Sewer
- Sanitary Sewer Overflow (SSO)
- HGL < 2' from Manhole Rim
- Pipe Full (Q >= Q Full)
- Pipe Full (Q < Q Full)
- 80% - Pipe Full
- < 80% Full
- Surface Water
- Waco City Limits
- Waco ETJ Limits

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 5-13: Future 2040 System (With Improvements) 5-Yr 6-Hr Storm Event Flow Model Results

G:\GIS\Projects\1-02231\Maps\Overall System Model Results.mxd

5.7 Summary of Deficiencies

There are a number of locations in the model where the results indicate pipes with insufficient capacity to carry the current or projected flows. These can be classified as either growth areas or capacity related problem areas. The growth areas are of primary concern because the increase in service area directly increases dry weather flows and RDII into the system. The capacity related areas are of concern for several reasons including age, condition, size, or slope of the existing system in these areas. The older collection system pipes tend to have leaky joints which increase RDII and rougher surfaces which increase pipe friction. The following locations require further analysis to determine the best options for future improvement as development occurs or represent locations that should be monitored for issues, since the model indicates HGL approaching the ground surface.

Growth Areas

- Village Lake Basin
- Carver Basin
- Speegleville Basin

Existing Capacity Constraints

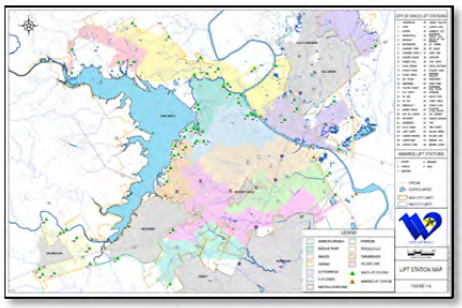
- West Bank Interceptor has a number of deficiencies.
- The Brazos, Barron's Branch and Cottonwood Basins have a number of sanitary sewer overflow hot spot areas and capacity related issues due to the age of the system. This older system is subject to high RDII rates.
- The hydraulic capacity of the gravity system downstream of the TSTC Lift Station and force main.
- The hydraulic capacity of the gravity system downstream of the Church Road Lift Station and force main.
- The Carver Basin above Lake Shore Drive needs further investigation. A Sanitary Sewer Assessment is recommended to determine the cause of the high RDII during the temporary flow monitoring period. It is assumed that future development will spread across the future service areas out to the edges. This maximizes the estimated RDII. If development is more concentrated, then the resulting estimated RDII would be less. Therefore, the model provides a "conservative" scenario for the Carver Basin which has a number of sections of pipe with the HGL within two feet of the surface. More study is recommended in this area to determine true RDII factors for localized areas.
- Upper sections of the Primrose Interceptor show the HGL within two feet of the surface. There are no reported SSOs

currently occurring here. It is recommended that this area be monitored for problems and if necessary, remedial steps could be to upsize or parallel this line or install a relief line down the I-35 frontage road (MH 1064005 to 1064010).

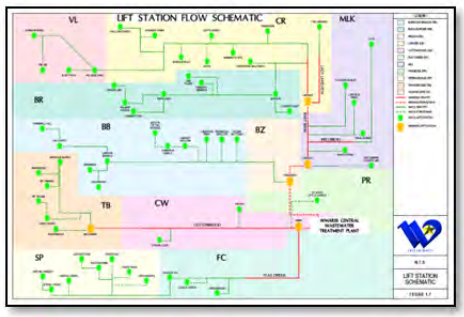
- The Cottonwood Basin above meter CW04 shows the model HGL within two feet of surface. However, there are no reported SSOs reported here. It is recommended that this area be monitored for problems and if a problem does arise, a cross link between the higher 15 inch line to the parallel lower 30 inch line (MH 1163008 to 1163012 and MH 1162005 to 1162001 or 1162008 to 1162004) could be installed.
- The Flat Creek Basin has substantiated SSOs, but the model does not corroborate with the existing system for 5-year, 6-hour event. The model shows some sections with the HGL within two feet of ground, but this may be due to infiltration in the region. It is recommended that this area be monitored for problems during rain events. If this area becomes a problem, then remedial action could be to parallel or upsize line (MH 1461074 to 1474007).

CHAPTER 6 – LIFT STATION ASSESSMENTS

6.1. Background



21 lift stations were selected for detailed evaluation.



The City of Waco wastewater collection system includes a total of 58 lift stations. These stations are listed in Section 2.2.4, Table 2-8. The location of these stations within the City system can be found in Section 2.2.4, Figure 2-6, Lift Station Map and Figure 2-7, Lift Station Schematic.

City of Waco Water Utility staff and Team members identified existing problematic or vulnerable lift stations based on condition and hydraulic capacity. Based on information provided by the City and the relative importance of a particular station in the wastewater system, **twenty one (21) lift stations were selected for detailed evaluation.** Detailed evaluations were not performed on the remaining thirty seven (37) stations. These 37 stations are the smaller stations within the collection system and are considered to have a much lower impact upon an operational failure. **However, over time, these smaller stations will require ongoing maintenance, equipment/pump replacements, and rehabilitation or replacement. As part of the Master Planning effort, the associated project costs for this future work should be included within the Asset Renewal Projects identified within the overall Capital Improvement Plan (CIP).** This effort did not include the evaluation of the 5 lift stations within the WMARSS system. These lift stations include Carver, LaSalle, Transfer, Woodway and Main lift stations.

The below graph provides the age of the 58 lift stations that are within Waco's collection system.

58 Total Lift Stations

0-10 Yrs Old – 11 Stations

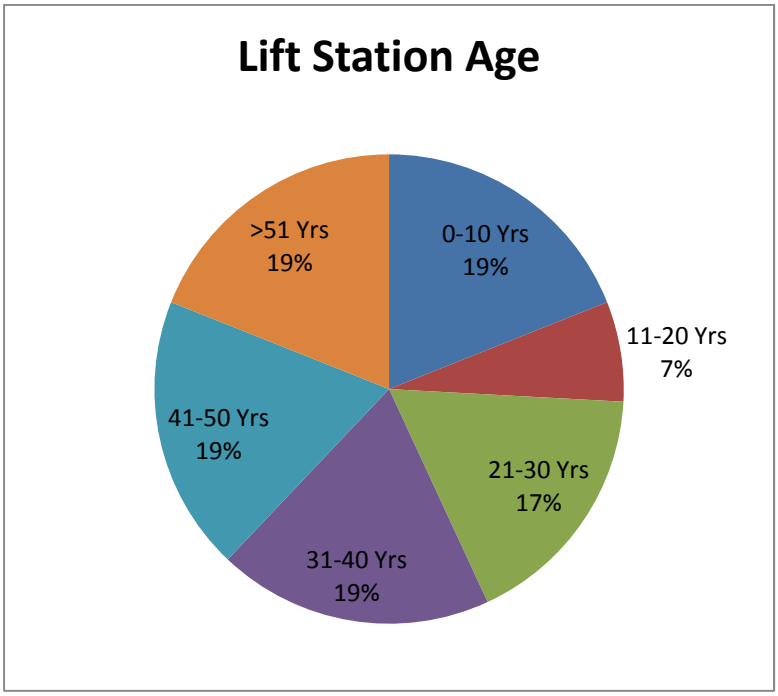
11-20 Yrs Old – 4 Stations

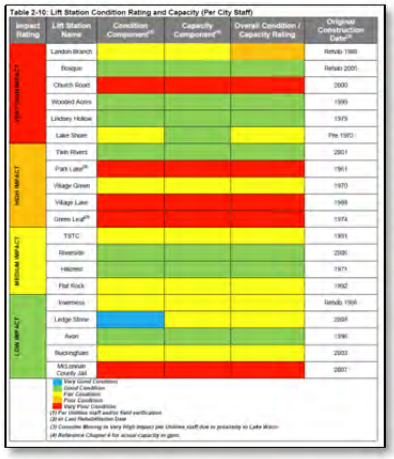
21-30 Yrs Old – 10 Stations

31-40 Yrs Old – 11 Stations

41-50 Yrs Old – 11 Stations

> 51 Yrs Old – 11 Stations





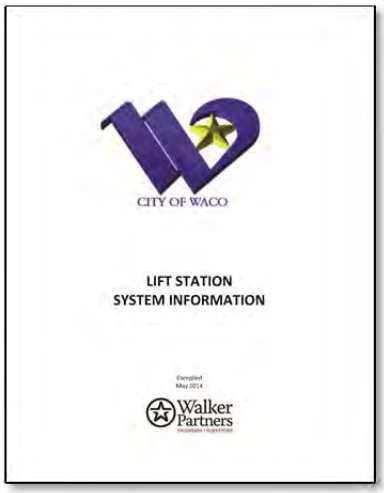
6.2. Review Previous Studies, Reports and Existing Data/Information

The City was unable to provide any previous engineering reports or studies in regards to the selected 21 prioritized lift stations. However, various City records were obtained including construction drawings and maintenance / operation records. **Water Utilities staff were able to supply pump data and pump curves for some of the stations. For the remaining stations, the Team contacted and coordinated with original pump/equipment suppliers to obtain data for the remaining stations.** The team met with City of Waco lift station staff to discuss historical knowledge of the existing lift stations which resulted in an initial ranking of the condition and capacity of each of the 21 prioritized lift stations. All information compiled related to existing condition, capacity and on-going problems with lift stations are summarized in Section 2.5.

6.3. Detailed Lift Station Evaluations

The detailed field investigations help to provide a basis for current condition and capacity status of the lift stations

The City of Waco Water Utilities department has the City divided into four zones with different personnel responsible for operation and maintenance of the lift stations in each zone. Team members went to each lift station and were accompanied by the appropriate personnel responsible for the station. The field investigations were performed in late January and early February 2014. Evaluations utilized existing City records and Water Utilities staff input. The field investigations help in providing a basis for current condition and capacity status as well as confirmed issues identified by Water Utilities staff.



Copies of the inspection reports, photos, pump curves and record drawings were combined into notebooks. **Copies of these notebooks were provided to the City in a separate binder *Lift Station System Data, May 2014*.**

6.3.1. Lift Stations Inventory Based Upon Detailed Evaluations

The final evaluations of the 21 priority stations were based upon City records, Water Utilities staff input, field inspections and additional document research data collected. Basic information such as number of pumps capacity and date of construction were confirmed. The data was additionally obtained for inclusion within the wastewater hydraulic model. **The lift station inventory based on the data gathered is presented within Table 6-1:**

Table 6-1: Lift Station Inventory

Lift Station	Avon	Bosque	Buckingham	Church Road	Flat Rock	Greenleaf	Hillcrest	Inverness	Lake Shore	Landon Branch	Ledge Stone
Major Sanitary Sewer Basin	Carver	Bosque River	Speegleville	Flat Creek	Village Lake	Bosque River	Barron's Branch	Twin Bridges	Twin Bridges	Barron's Branch	Speegleville
Year Built (Rehabilitation Date)	1996	1971	2003	2000	1992	1974	1971	1995	Pre 1970 (1982)	1970 (1988)	2008
Service Area											
Primary Load Type	Residential	Residential	Residential	Residential	Residential	Residential	Residential	Residential	Residential	Residential	Residential
Wastewater Flows[2]											
Avg. DWF (gpm)	N/A	395	N/A	310	30	25	30	N/A	65	155	N/A
Peak WWF (gpm)	N/A	2,750	N/A	>1,100	N/A	N/A	N/A	N/A	N/A	>2,300	N/A
General Type	Dry	Dry	Wet	Wet / Dry	Dry	Dry	Dry	Wet	Dry	Dry	Wet
Pumps											
Type	Centrifugal	Centrifugal	Submersible	Submersible & Centrifugal	Centrifugal	Centrifugal	Centrifugal	Submersible	Centrifugal	Centrifugal	Submersible
Manuf./Model	Cormel/ 16 F8-4NNT	Aurora/ 612A	Hydromatic/ 54PX1000JC & KJB/ KRT 80-250	Ingersoll/ 4FM16FR6A & Hydromatic/ S4L	Aurora/ 653A	Fairbanks/ 4x4	Fairbanks/ Fig. 5433B	Homa/AV432 & Myers/ CAT 4RCX250	Cornell/ 4414T-VC18	Aurora/ 613A & Aurora/ UTD	Hydromatic/ H4QX
Number	2	3	2	4	2	2	2	2	2	3	2
Motor Size (HP)	15	60	10	100	10	20	25	25-30	75	75	25
Rating	250 gpm @ 85 TDH	2250 gpm @ 67 TDH	250 gpm @ 68 TDH	1100 gpm @ 200 TDH & 1111 gpm @ 109 TDH	365 gpm @ 43.6 TDH	570 gpm @ 80.5 TDH	400 gpm @ 110 TDH	150 gpm @ 160 TDH	850 gpm @ 210 TDH	2110 gpm @ 89.5 TDH	125 gpm @ 122 TDH
Wet Well											
Top Elev. (ft)	505.10	396.00	509.50	507.00	503.00	473.75	529.60	507.25	502.50	504.10	521.50
Bottom Elev. (ft)	486.10	365.00	484.09	479.40	478.00	456.45	520.93	488.50	490.50	475.10	509.00
Circular	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Diameter (ft)	6	-	7	-	-	8	8	6	10	-	6
Area (ft)	-	324	-	73.3	240	-	-	-	-	225	-
Total Depth[3] (ft)	19.00	31.00	25.41	27.60	25.00	17.30	8.67	18.75	12.00	29.00	12.50
Total Volume (ft)	537	10,044	978	2,023	6,000	870	436	530	942	6,525	353
Inlet Pipe											
Diameter (in)	8	12, 24	10	21	10, 15	6, 8, 10	6	6	8, 10	6, 10	8
Force Main											
Diameter (in)	6	16	6	12	6	6	8	4	10	14	4
Discharge Elevation (ft)	439.59	392.50	548.32	717.00	508.60	519.10	579.50	601.01	628.45	553.54	-
Approx. Length (ft)	2,480	450	1,610	14,900	1,830	670	1,660	2,980	3,760	4,140	3,220
Generator											
On-Site	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No

[1] Date shown with " – " means data was not applicable or unavailable during preparation of report
[2] Wastewater flows are based on the model run for 2014 and not actual flow meter or run time data (See Chapter 5)
[3] Total Depth = vertical distance from bottom of wet well to inside top of wet well

Table 6-1: Lift Station Inventory (Continued)

Lift Station	Lindsey Hollow	McLennan County Jail	Park Lake	Riverside	Syrian Club	TSTC	Twin Rivers	Village Green	Village Lake	Wooded Acres
Major Sanitary Sewer Basin	Barron's Branch	MLK	Bosque River	Speegleville	Cottonwood	MLK	Speegleville	Bosque River	Village Lake	Twin Bridges
Year Built (Rehabilitation Date)	1979	2007	1961	2006	1980	1991	2001	1990	1988	1999
Service Area										
Primary Load Type	Residential	General Commercial (Prison)	Residential	Residential	Residential	General Commercial (College)	Residential	Residential	Residential	Residential
Wastewater Flows[2]										
Avg. DWF (gpm)	120	125	100	15	N/A	220	45	10	180	370
Peak WWF (gpm)	N/A	145	>640	N/A	N/A	>950	N/A	N/A	>600	N/A
General Type	Dry	Wet	Dry	Wet	Dry	Dry	Wet	Dry	Dry	Wet
Pumps										
Type	Centrifugal	Submersible	Centrifugal	Submersible	Centrifugal	Centrifugal	Submersible	Centrifugal	Centrifugal	Submersible
Manuf./Model	Fairbanks/ C3DAO	Hydromatic/ 54MVX1500FC	Cornell/ 4NNT-VC16	Hydromatic/ S4KX	Hydromatic/ RP43 (4x6)	Cornell/ 6NHTA-2R & Cornell/ 6NHTA	Hydromatic/ SB4X2000JC	S & L/ 4B2A	Fairbanks/ B5420	Hydromatic/ 54TX
Number	2	2	2	2	2	3[4]	2	2	2	3
Motor Size (HP)	15	15	25	25	7.5	60	20	10	15	100
Rating	830 gpm @ 30 TDH	165 gpm @ 65 TDH	640 gpm @ 76 TDH	475 gpm @ 74 TDH	200 gpm @ 40 TDH	500 gpm @ 140 TDH	750 gpm @ 52 TDH	650 gpm @ 38 TDH	600 gpm @ 50 TDH	1050 gpm @ 178 TDH
Wet Well										
Top Elev. (ft)	402.50	398.81	469.45	503.50	634.50	407.70	-	513.20	509.00	504.00
Bottom Elev. (ft)	393.80	366.43	457.45	470.00	619.80	379.00	-	498.70	459.50	474.00
Circular	No	Yes	No	No	Yes	No	Yes	Yes	Yes	No
Diameter (ft)	-	6	-	-	6	-	8	6	8	-
Area (ft)	143	-	71.5	144	-	120	-	-	-	125
Total Depth[3] (ft)	8.70	32.38	12.00	33.50	14.70	28.70	-	14.50	49.50	30.00
Total Volume (ft)	1,244	916	858	4,824	416	3,444	-	410	2,488	3,750
Inlet Pipe										
Diameter (in)	8, 15	10, 15	15	12	6, 8	12, 24	15	6, 10	10, 18	8, 12
Force Main										
Diameter (in)	8	4	12	8	6	8, 16	10	8	12	12
Discharge Elevation (ft)	412.80	388.12	437.10	536.39	645.80	432.50	518.28	526.00	494.00	611.83
Approx. Length (ft)	475	3,020	1,990	2,100	1,420	8" - 12,000 16" - 18,750	3,380	3,860	9,380	8,960
Generator										
On-Site	No	No	Yes	Yes	No	Yes	No	No	No	Yes

[1] Date shown with " – " means data was not applicable or unavailable during preparation of report
[2] Wastewater flows are based on the model run for 2014 and not actual flow meter or run time data (See Chapter 5)
[3] Total Depth = vertical distance from bottom of wet well to inside top of wet well
[4] 3 pumps installed at station even though 8-inch force main in use

6.4. Dry Weather / Wet Weather Analysis

In pursuit of flow data, Walker Partners obtained pump run times from the City. The pump run times were previously recorded from the onsite SCADA units. The collected run times came from the 21 priority stations for the periods of September to November 2013. This pump data represents average pump cycle times, averaging the previous 100 pump starts. These cycle times can be useful in regards to evaluating pump performance, but could not be converted to flow data, since pump starts per a unit of time (hour, day) was not available.

The existing SCADA programmable logic controllers (PLCs) are considered to have inaccuracies and have recently been replaced (March 2014) with Allen Bradley PLCs. The new PLCs have a greater ability for collecting data and have been fully programmed within the last several of months. The Team obtained data from the new SCADA units for the Church Road, Riverside, Twin Rivers and Village Lake stations.

6.5. Identification of Problem Areas: Capacity, Mechanical Problems and/or Significant Structural Deterioration.

The major structural, mechanical and electrical/control systems and components were evaluated for each station.

The detailed field investigations conducted on each of the 21 priority lift stations provided a basis for condition and hydraulic capacity ratings, resulting in identifying future CIP projects. These evaluations identified problem areas to better understand the current condition. The major systems/components for each station were evaluated, which included structural, mechanical and electrical/control systems. **The priority lift stations have the largest pumping capacities which generally place them on the downstream segments of the collection system and therefore creates the highest overall risk impact.**

The wet well structure of each lift station was evaluated since these structures are typically subject to deterioration from wastewater gases. Some of the stations utilize pre-manufactured steel dry pits which are also subject to corrosion. Next, the mechanical systems (pumps, valves, piping) and electrical systems (control panel, wet well controls, power distribution) were evaluated during the inspections. Finally, proper coatings were observed on piping and valves. Coating failures and lack of final coatings were noted at newer stations.

A general rating was given to each station based on condition. Condition ratings were based on the field investigation and reported problems from the City staff (reference Section 2.5, Table 2-10). **The field investigation generally confirmed the operational and maintenance problems experienced by City operators.**

A color coded system was used to represent the various condition and capacity ratings for each lift station:

Very Good Condition		***Very Good Capacity***
Good Condition		***Good Capacity***
Fair Condition		***Fair Capacity***
Poor Condition		***Poor Capacity***
Very Poor Condition		***Very Poor Capacity***

Table 6-2: Lift Station Condition Rating and Capacity

Lift Station Name / Impact	Age/ Years[2]	Condition Component[1]	Capacity Component	Overall Risk Rating[3]	CIP Recommendations
Avon	18		250 gpm		>20 yrs.
Bosque	43		3750 gpm		11-20 yrs.
Buckingham	11		250 gpm		>20 yrs.
Church Road	14		1100 gpm		1-10 yrs. [4]
Flat Rock	22		365 gpm		11-20 yrs.
Green Leaf	40		570 gpm		1-10 yrs. [4]
Hillcrest	43		400 gpm		11-20 yrs.
Inverness	44		150 gpm		>20 yrs.
Lake Shore	50±		850 gpm		1-10 yrs.
Landon Branch	44+		2300 gpm		1-10 yrs.
Ledge Stone	6		125 gpm		>20 yrs.
Lindsey Hollow	35		830 gpm		1-10 yrs.
McLennan County Jail	7		145 gpm		1-10 yrs. [4]
Park Lake	53		640 gpm		1-10 yrs.
Riverside	8		475 gpm		>20 yrs.
Syrian Club	34		200 gpm		1-10 yrs.
TSTC	23		560 gpm		3-10 yrs.
Twin Rivers	13		750 gpm		11-20 yrs.
Village Green	44		650 gpm		3-10 yrs.
Village Lake	26		600 gpm		1-10 yrs. [4]
Wooded Acres	15		1395 gpm		>20 yrs.

(1) Per 2014 Lift Station Evaluations
(2) As of 2014
(3) Risk Rating based on Impact Rating, Condition and Capacity Component
(4) Improvements are required near term (immediately)

Very Good Condition / Capacity
Good Condition / Capacity
Fair Condition / Capacity
Poor Condition / Capacity
Very Poor Condition / Capacity

Each stations general capacity rating is shown in Table 6-2. Station records were collected in regards to pump run times in an attempt to determine average and/or peak flow data. The City SCADA system records pump times per an average of the last 100 pump cycles. The average pump cycle time could not be translated into useable average or peak daily flow data. Therefore capacity ratings were heavily based upon Water Utilities staff input and temporary flow monitoring results.

Table 6-3 was developed by evaluating the overall risk of each structure in order to help place the priority lift stations within the overall CIP schedule. A risk rating was assigned to each evaluated station as low, medium, high, or very high risk. **The final risk rating placement within the matrix is based on the station overall impact/significance within the City's system, the capacity rating, and the condition rating.** Table 6-3 presents the risk status for each priority lift station.

Table 6-3: Condition Rating and Capacity Risk Matrix

	VERY GOOD	GOOD	FAIR	POOR	VERY POOR
LOW IMPACT	A V	O N BUCKINGHAM LEDGE STONE INVERNESS	FLAT ROCK	McLENNAN JAIL SYRIAN CLUB	
MEDIUM IMPACT		RIVERSIDE	HILLCREST	TSTC	GREEN LEAF
HIGH IMPACT		TWIN RIVERS	LAKE SHORE VILLAGE	GREEN	PARK LAKE VILLAGE LAKE
VERY HIGH IMPACT		BOSQUE WOODED ACRES	LANDON BRANCH LINDSEY HOLLOW	CHURCH	ROAD

Low Risk

Medium Risk

High Risk

Of the 37 remaining lift stations that were not evaluated and placed in a specific CIP category. These stations are small and are considered to have a low impact status in case a failure occurs. These stations will require ongoing maintenance, repair and equipment replacements prior to their final abandonment, replacement or a major improvement. Improvement projects for these smaller stations have not been placed within a 0- 20 year CIP, but were spread out beyond 20 years to 60 years.

6.6. Lift Station Evaluation Criteria and Ranking

The priority lift stations were categorized into three groups based upon their overall risk:

- 1 to 10 year projects,
- 11 to 20 year projects, and
- Over 20 year projects.

The stations were placed in these CIP groups based on specific criteria. Below is a more detailed description of each Capital Improvement Plan rating, the criteria for placing stations within that CIP group, and the stations within each CIP category.

6.6.1. Stations Requiring Capital Improvements (Yrs. 1-10)

Within the Yr. 1-10 category, the stations were broken into two subcategories: Immediate Need and 3-10 Year projects.

Immediate Need Lift Stations
Church Road
Green Leaf
Village Lake

Immediate Need - An immediate need rated station is one that the defects are significant enough to warrant starting a design/engineered solution resulting in an implemented correction one to three years out. Criteria for placing a station in the immediate need group were either having a very poor to poor (red or orange) rating in condition and insufficient capacity (red) and having an overall high risk rating (red) as shown in the condition risk matrix (Table 6-3).

Three stations were determined to be warranted an immediate need status: these stations are Church Road, Green Leaf and Village Lake. It should be noted that McLennan Jail is relatively a new station in good condition and could be placed as a 3-10 year CIP project, but due to its capacity rating it's been placed in the immediate need list.

Village Lake Lift Station

The other immediate need stations have a poor to very poor condition rating and also do not have sufficient capacity. Church Road is only 14 years old; however the station is not the typical station in regards to pumping against high heads. Pumping against very high pressures involves operating two pumps in series which can result in pump operating and maintenance problems. The Church Road station has recently experienced pump failures resulting in pump replacements and using a temporary pump set up. Control system modifications were also required to facilitate proper pump sequencing. Also, the associated 12-inch ductile iron force main was not poly wrapped during construction and has corrosion problems. The Green Leaf station is considered to be in poor condition and its site is subject to flooding. This station has been previously flooded and exhibits severe corrosion on piping, valves and control/electrical elements. The Village Lake station has limited capacity, a corroding dry pit, aging controls, and currently has one pump out of service.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

3-10 Yr. Projects - Criteria for placement in the 3 to 10 year group are stations having medium to higher impact, a fair or worse condition rating, and insufficient capacity. Based on these ratings, stations in the 3 to 10 year group are considered medium to high risk as shown in the condition risk matrix (Table 6-3).

Eight stations were placed in this group: Lake Shore, Landon Branch, Lindsey Hollow, Park Lake, Syrian Club, TSTC, McLennan County Jail and Village Green. This group of stations are generally older than most. Three stations are around 50 years of age and all are greater than 23 years old. Despite their age they are functional enough to be placed in the 3 to 10 year CIP group. However, most of the stations in this group are in poor condition and exhibit signs of noticeable deterioration. Six stations (all but TSTC) exhibit corroding wet wells. Also, three stations have packaged steel dry pits that are corroding. TSTC is presently rated fair in capacity and condition, however, the associated force main is relatively long and in poor condition.

Park Lake Lift Station

The Park Lake station is approximately 53 years old and has a very poor condition and capacity ratings. Several problems were noted including unsecure site, vandalized electrical systems, corroding electrical systems and infrastructure, corroding wet well, and difficult access for equipment removal and personnel.

The Syrian Club station is on a very small site adjacent to an apartment complex. The station layout does not present easy access to remove pumps for repair/replacement. The station is in poor condition and is under capacity. Due to the above stated conditions, it is recommended that Park Lake and Syrian Club stations be addressed as part of the 3 to 10 year group.

6.6.2. Stations Requiring Capital Improvements (Yrs. 11-20)

11-20 Year Lift Stations
Bosque
Flat Rock
Hillcrest
Twin Rivers

Criteria for placement in the 11 to 20 year group is stations that are in a condition that justified a longer projected service life than the 3 to 10 year group, but were not newer stations having a very good condition rating (blue). Also, these stations are considered low to medium risk as shown in the condition risk matrix (Table 6-3).

Four stations were placed in this group: Bosque, Flat Rock, Hillcrest and Twin Rivers. These four stations are either relatively new or had recent rehabilitation and/or major equipment replacements. All these stations are considered in good pumping/mechanical condition, however Bosque, Flat Rock and Hillcrest have pre-packaged steel cylinder dry pits which presently exhibit wall/floor, piping and control panel corrosion, therefore these stations will eventually require rehabilitation and or replacement. Another option is to perform intermediate rehab or significant maintenance to critical components such as preventing further corrosion to the steel dry pit structure. The Twin River station is a relatively new submersible station that could be pushed out further for replacement or a major rehabilitation, but will likely require intermediate maintenance and pump repair/replacement.

Bosque Lift Station

6.6.3. Stations Requiring Capital Improvements (> 20 Yrs.)

> 20 Year Lift Stations
Avon
Buckingham
Inverness
Ledge Stone
Riverside
Wooded Acres

Stations that had good or better condition rating, an average to high capacity rating, and a low impact rating were placed in the over 20 year CIP group. These stations are considered low risk as shown in the condition risk matrix (Table 6-3).

Six of the priority lift stations were placed in this group: Avon, Buckingham, Inverness, Ledge Stone, Riverside, and Wooded Acres. All these stations were built in the mid-1990s or later. All six stations have wet wells, valve vaults or dry pits in good structural condition. The pumps, piping and valves are presently in good condition or could be easily repaired and/or replaced due to good access.

It should be recognized that stations categorized in the longer CIP time frames (over 10 years) could end up needing earlier attention depending on the continuous maintenance. It's expected that the stations cannot be neglected and will require intermittent control/electrical component and pump replacements prior to the lift station abandonment and /or replacement.

Wooded Acres Lift Station

6.7. TCEQ Code Compliance

TCEQ Chapter 217 of the Texas Administrative Code provides various lift station requirements that municipalities must adhere to for proposed new construction, renovating or re-rating part of a wastewater collection system. Hence, for the existing City stations, the latest 217 requirement may not apply unless the station is being replaced, rehabilitated, or upgraded. However, described below are areas that the City of Waco lift stations could be modified for compliance to the latest TCEQ code.

Chapter 217.59 requires that lift stations must restrict access by an unauthorized person and must include an intruder resistant fence, enclosure or a lockable structure. The field evaluations noted that Inverness and Village Green lift stations are not enclosed by fencing, however Village Green's dry pit is considered a lockable structure but the associated wet well is currently unsecure.

Chapter 217.63 requires lift stations to have reliability based on retention capacity or emergency provisions in case of power failure. An emergency provision generally means backup power provided by a generator. Backup power can be provided by a portable generator equipped with a transfer switch and generator connection. Eleven of the twenty one lift stations evaluated had backup generators and at least three (Buckingham, McLennan Co. Jail, and Twin Rivers) were equipped for a portable generator. Seven stations had no provisions for a portable generator. The stations without generator connections may have sufficient retention capacity in their wet wells and associated incoming gravity line; however it is recommended that the retention capacity and reliability of these stations during a power outage be further studied to assure the current code requirement is satisfied.

Chapter 217.60(c) requires ladders in the dry wells to be out of non-conductive material. The majority of the existing lift station that have pre-manufacture steel dry pits have ladders and/or elevators constructed of steel. Some of the older engineered stations, such as Park Lake and Landon Branch, with concrete dry pits are also accessed by steel stairs. It was noted that the Park Lake ladder supports exhibit moderate to severe corrosion. Noteworthy is the Greenleaf lift station dry pit that is subject to flooding, but contains electrical components and is accessed by a steel ladder.

Chapter 217.60(d) requires ventilations for all dry and wet wells. Wet wells that are provided with passive ventilation must have air vents with a minimum of 4-inches. It was noted that there are few stations with no wet well venting, such as Park Lake and Lindsey Hollow. Other stations had limited or restricted venting such as Flat Rock, Syrian Club, and Village Lake. Inadequate wet well ventilation creates a concentrated gas environment which contributes to higher corrosion rates.

Chapter 217.60(h) requires dry wells/pits to have dual sump pumps in case of flooding. Most of the dry pits are equipped with sump pumps but not two pumps.

Chapter 217.60(b) states that pump cycle times must equal or exceed a set value depending on the size of the pump motor. For example, a pump motor with a horse power less than 50 hp requires a minimum cycle time of 6 minutes. The average cycle times for several of the stations are shorter than the TCEQ requirements. This is likely the result of inadequately sized (small) wet wells. The shorter than required cycle times will result in higher number

of pump starts, shorter pump life and larger power consumption.

Chapter 217.60(f) requires a lift station to have permanent hoisting equipment or be accessible to portable hoisting equipment for removal of pumps, motors, valves and other critical components. It's common for stations not to have on-site hoist, since many pump suppliers have service trucks with hoists. However stations should be laid out for easy access to key equipment. A few of the evaluated station had difficult and tight access for pump and motor removal such as Syrian club.

Chapter 217.59(c) states that stations designs shall include all electrical and mechanical equipment to be designed to withstand and operate during a 100 year flood event. Many of the evaluated Waco stations have pre-manufactured steel dry pits with non-submersible pumps, motors and control panels which makes this equipment more vulnerable to flooding. Greenleaf is one such station that has a dry pit containing pumps, motors, and controls that has been flooded. In contrast submersible stations normally have the electrical panels above grade or mounted on a raised platform. Submersible pumps also have the advantage of not sustaining damage during a flooding occurrence.

Finally, in respect to good design practice, it is recommended that pressure gauges and/or taps on discharge lines be installed to provide a means to read discharge pump pressures. Actual pressure readings and manufacturer pump curves allow a close estimate on the stations flow rate and efficiency to be determined. Providing a small valve (normally closed) with each pressure tap will help keep gauges functioning and free from wastewater clogging.

CHAPTER 7 – RISK ANALYSIS – CONDITION AND HYDRAULIC CAPACITY

7.1. Risk Analysis

The City of Waco collection system was analyzed for:

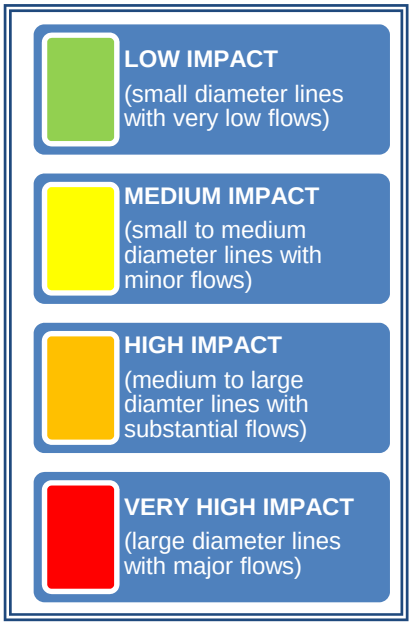
1. **Likely Peak Wet Weather Inadequacies.** The Team's analysis included both existing conditions as well as expansion of the collection system to accommodate future development conditions. This evaluation allows for infrastructure that is planned for construction by private development to be compared with the City's planned ultimate infrastructure and modified as required to include over-sizing facilities, adjusting alignments, and negotiating project cost sharing agreements. The flow monitoring and hydraulic analysis tasks identified surcharging / bottlenecked (problem area) sewers in order to develop flow control plans that include relief sewers and/or lift station improvements. These same evaluation methods were used to validate if there was **not** a current need for a project that has been historically identified. The Team also analyzed, identified and qualified areas that are directly impacted by inflow and the long term effects of infiltration on the collection system. These analyses were performed in order to identify where to focus and prioritize both future Capital Improvement Program efforts as well as where City Staff could focus their efforts on local repairs.

2. **Operational Inadequacies**. The City has specific historical problem areas and sanitary sewer overflow locations where they are not within regulatory compliance requirements. For example, **from June 2010 to January 2013, City of Waco staff reported a total of 106 repeatable sanitary sewer overflows at approximately 30 different locations within the collection system as a result of wet weather events.** Sewage spills are costly in terms of staff time, potential fines, property damage, and they can represent a health risk. These analyses were performed in order to provide recommendations that will allow the City to continue to make strides towards staying in compliance with TCEQ (and EPA) regulatory requirements.

3. **Vulnerability to Risk**. The vulnerability risk analysis assists the City in managing risk within both the City of Waco collection system as well as the WMARSS collection system. **The projects that have been identified and prioritized were analyzed in conjunction with the WMARSS collection system projects identified as part of the *WMARSS Large Diameter Interceptor Improvements Report* as well as the WMARSS Flat Creek Interceptor and Bull Hide Creek Interceptor improvements, and the WMARSS Central and Bull Hide treatment facilities completed within the last five years.**

Risk-based approaches identify both structural condition and hydraulic capacity deficiencies.

Risk-based approaches (strategies) are becoming more and more commonly utilized by leading utilities that implement best practice asset management programs. These types of approaches identify both structural condition and hydraulic capacity deficiencies in order to effectively prioritize and schedule necessary capital improvement projects.



The following information was collected and used as part of the Team's risk analysis:

- The Review of Previous Studies / Reports / Existing Data / Information
- The Identification of Problem Areas, Structurally Deficient Segments & Lift Stations with Water Utilities Staff
- Temporary Flow Monitoring
- Hydraulic Model and Calibration
- Hydraulic Analysis
- Lift Station Assessments

Each piece of information was compiled and examined to determine the severity of potential complications for the purpose of ranking and prioritizing recommended projects. The information was examined alongside the risk rating matrix to achieve the optimum solutions in terms of cost, benefit, and financial strategies. The basic risk rating matrix takes into account the structural condition component and the hydraulic capacity component. The basic risk-based rating matrix utilized as part of prioritizing projects was based upon the format shown in Table 7-1:

Table 7-1: Basic Risk-Based Rating Matrix

Risk Rating = Condition (or Capacity) x Consequence		Condition (or Capacity)				
		VERY GOOD	GOOD	FAIR	POOR	VERY POOR
Consequence of Failure	LOW IMPACT					
	MEDIUM IMPACT					
	HIGH IMPACT					
	VERY HIGH IMPACT					

Each identified project (12-inch diameter and larger) was based upon the following criteria:

Structural Condition Analysis and Rating – This category was rated from very good to very poor and is based upon City of Waco staff knowledge, material type, age, and any inspection/report/study

data available. Limited data was available from the City that could be utilized to assist in the accurate characterization of the condition of the bulk of the pipelines (both gravity sewer and force main) within the collection system. Therefore, the structural condition components were weighted (scored) based primarily on pipe age, pipe material type and staff historical operational knowledge and the consequence should the line fail.

Root Intrusion and Longitudinal Cracking along a clay tile pipe.

Capacity Analysis and Rating – This category was rated from very good to very poor and is based upon calibrated model results that were reconciled with operations data (Rainfall Event SSO locations from work order system). The capacity components were weighted (scored) to assign an overall rating allowing the ability to identify and prioritize the most pressing capacity needs within the system.

The various condition and capacity ratings were utilized to develop the final risk ratings. These final ratings provide the ability to objectively rank the most pressing improvement projects. This approach is both logical and defensible and allows a utility to prioritize and schedule its capital improvement projects throughout its wastewater system. This approach additionally allows a utility to address the high risk capacity and rehabilitation (to include Asset Renewal) projects identified in the Capital Improvement Program and continues to assess the priority of projects as more condition assessment data becomes available.

Projects were identified within one of three categories:

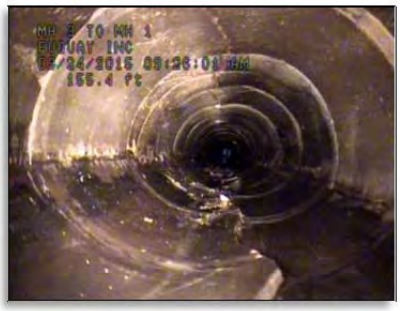
1. ***Short-Term (1-10 Years)***
2. ***Long-Term (11-20 Years)***
3. ***Future (> 20 Years)***

At that point, the risk-based analysis was used to prioritize projects into one of three categories within the Capital Improvement Program:

- Short-term (1-10 Yr. Needs)
- Long-term (11-20 Yr. Needs)
- Future (>20 Yr. Needs)

The Capital Improvement Program will map out the City's future needs (20-Year and beyond) by identifying both short and long-term improvements. This information can be used by the City to plan and budget for capital improvement projects over the next decade to make sure that the right improvements are built at the right time.

It is not uncommon for master planning efforts to exclusively focus on meeting capacity needs largely associated with population growth. However, the City of Waco currently faces an aging wastewater infrastructure, the threat of increased wet weather sanitary sewer overflows (SSOs), as well as capacity issues. In order to proactively address these issues, the Capital Improvement Program embraced a risk-mitigation approach to identify and prioritize both capacity improvement and rehabilitation (to include Asset Renewal) projects. **The Capital Improvement Program was developed to ensure that both collection system capacity projects (12-inch diameter and larger pipe projects) and a series of "Asset Renewal" projects are identified and addressed.** This strategy will assist the City in achieving regulatory compliance by reducing SSOs.



Addressing the physical condition and remaining useful life of a city's wastewater collection system is essential to avoid sewer overflows and to efficiently operate the wastewater collection system. It is recommended that the City work towards obtaining data, including but not limited to, installation year, pipe material and diameter, maintenance related information, and other field conditions documented by field crews which will allow the City to develop a useful life assessment / system analysis. Such an analysis would allow the City to evaluate the average lifecycle of concrete pipe, vitrified clay pipe (VCP), polyvinylchloride pipe (PVC) and other pipe materials that constitute the City's collection system. Based on the average lifecycle for each pipe material type, an estimated timeline can then be projected for replacement and rehabilitation improvements with the ultimate goal of minimizing the total pipeline replacement and maximizing the total pipeline rehabilitation, while minimizing capital cost and community impacts. The life assessments can be expanded to include manhole repair, rehabilitation, or replacement.

The first "Asset Renewal" project includes 51 locations that were identified by the Water Utilities staff. The total length of pipe included as part of these projects comprise approximately 4% of the gravity collection system and is estimated to cost approximately $39,000,000.00.

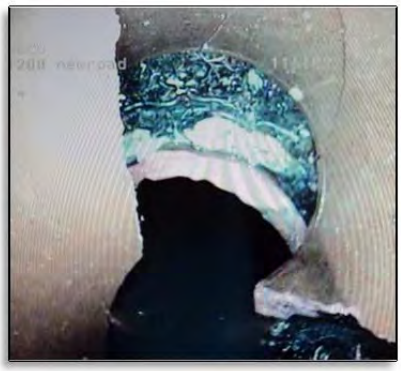
Chapter 8 contains detailed project descriptions for the "Asset Renewal" projects. These **projects primarily address 6-inch, 8-inch and 10-inch pipes within the City's existing collection system identified as being structurally deficient and/or inadequate hydraulic capacity**. The first "Asset Renewal" project includes 51 locations throughout the system that were identified by City Water Utilities staff and compiled by the Team as part of our efforts to identify historical problem areas. The total length of pipe included as part of the 51 identified locations comprises approximately 4% of the gravity collection system.

Additional Recommended Asset Renewal Projects:

- ***2019: Asset Renewal Project No. 2***
- ***2023: Asset Renewal Project No. 3***
- ***2027: Asset Renewal Project No. 4***
- ***2031: Asset Renewal Project No. 5***

A series of four additional future "Asset Renewal" projects are recommended in the final 20-Year Capital Improvement Program to address small diameter (6-inch through 10-inch) structurally deficient pipes that have not been identified within the collection system at this time. **City staff and Team members presume that at least 60% (1,750,000 LF) of the existing 6-inch, 8-inch and 10-inch lines within the City of Waco collection system are composed of vitrified clay tile pipe that is currently 50 years old or older.** This cannot be verified due to lack of historical records (record drawings, GIS data, etc.). In addition, a large percentage of these lines are located at the rear of lots and in areas with vegetation that that typically allow root intrusion or include poorly compacted backfill that has, over time, helped to compromise the integrity of the original pipe material. The Team and City staff have agreed that at least 20% of the existing small diameter lines (approximately 600,000 linear feet of pipe) will require attention within the next 20-year planning horizon of the CIP. **This equates to replacing or rehabilitating approximately 1% of the collection system per year for the next 20 years. This type of "Asset Renewal" program is defensible to current regulatory agents and would focus on the replacement and rehabilitation of lines that are in very poor structural condition as opposed to spending significant amounts of money in hopes of**

As part of the Master Planning effort, City staff agreed that 20% of the existing lines should require attention within the next 20 year planning horizon. The EPA expects that by the year 2020, more than 40% of major sewer lines will be in poor, very poor, or inoperable conditions.



Offset joint and pipe cracking along a clay tile sewer line.

reducing inflow and infiltration within the system but not addressing the system's structural "hot-spots". The EPA expects that by the year 2020, that more than 40% of the country's 600,000 miles of major sewer lines will be in poor, very poor, or inoperable condition.

Should the "Asset Renewal" projects not be accomplished at the end of 20 years, the existing wastewater resources that are currently 50 years old (or older) today would then be 70 years old (or older). The typical life expectancy of municipal sewers can vary greatly, but under normal conditions it is generally accepted to be in the range of 40-50 years for concrete, vitrified clay tile and steel wastewater pipes. However, across the country, wastewater utilities are seeing that the rate of degradation is increasing in their systems and reducing the life expectancy of their assets. Both state and federal legislation mandate the use of water saving devices in order to reduce water usage. As more and more of these devices are installed, the resulting wastewater chemistry changes and becomes more caustic to existing pipe materials. The production of hydrogen sulfide gases within the collection system has also increased significantly. These intensified hydrogen sulfide gas concentrations have increased the corrosion rate of municipal sewers (mainly those manholes and pipelines constructed of concrete or metal), thereby subjecting today's wastewater infrastructure to much more corrosion than seen in the past. While structural problems and collapses take years to develop, they are now regularly occurring around the US.

WMARSS (as well as the City of Waco) has not been immune to this problem. Within the last two decades, WMARSS has been affected by a number of concrete pipe collapses. In 2000, the EPA estimated that municipal sewers subject to corrosion are failing six times faster than the rate that they're being repaired. Finally, these wastewater chemistry changes have also increased the occurrence and degree of local odor generation. **The result is ultimately costing wastewater utilities (and their taxpayers) in such a way that debt service in many of America's cities is becoming an ever-increasing percentage of annual revenue as well as driving rate increases.**

Historically, Waco's wastewater utility renewal/replacement program has been primarily driven by available funding in the City's annual utility budget. This funding method only provided the Water Utilities staff with the ability to address and complete projects that concentrated on the most prominent and crucial deficiencies in the existing collection system. This is not unlike how many other utilities are making decisions and can be referred to as the "squeaky wheel gets the grease" syndrome. Unfortunately, this approach has caused the City to fall farther and farther behind in addressing other critical inadequacies. The City of Waco is not currently under a consent decree with the Environmental Protection Agency (EPA), but it does have a voluntary Sanitary Sewer Overflow Initiative (SSOi) with the Texas Commission on Environmental Quality (TCEQ). The City's

SSOi program as well as its commitment to providing excellent service to its citizens requires that this shortfall be mitigated.

The Capital Improvements Program (to include "Asset Renewal" projects) which is identified in Chapter 8 addresses aged wastewater pipes on the verge of structural failure (as well as to remove ground water infiltration from the system) and provide additional hydraulic capacity in locations that are currently deficient during wet weather events.

Significant portions of the larger diameter pipes in the lower limits of the collection system are constructed with Reinforced Concrete Pipe (RCP). A significant percentage of these lines were originally installed in the 1950's and 1960's. Typically, uncoated RCP does not always perform well in conditions where large volumes of hydrogen sulfide are generated. As previously discussed, hydrogen sulfide gases are present in domestic wastewater and can change from a relatively harmless liquid state to a gaseous state through the agitation of the wastewater. Due to the general age of many of the gravity interceptors constructed with plain concrete pipe or reinforced concrete pipe, **a general statement can be made that a large percentage of the existing concrete pipe in service within the City of Waco collection system is nearing the end of its expected design life.** This represents a significant risk of major pipeline failure to the City and the citizens served by these aged pipelines. From conversations with City Utilities staff, a cursory review of available data and information, and knowledge of system problems over the previous decade, the above conclusion is well supported.

It is generally accepted that the life expectancy of concrete sewer pipe is 40-50 years under normal conditions.

Clay tile fragment in line attributable to upstream pipe collapse.

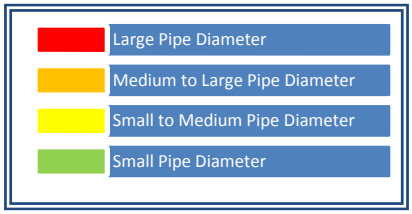
For the additional future "Asset Renewal" projects (Asset Renewal Project No's. 2, 3, 4 and 5), the City can continue to implement procedures similar to those that were utilized to develop the project listing for Asset Renewal Project No. 1. On the other hand, the City should consider engaging in prioritized Sanitary Sewer Condition Assessments. Sanitary Sewer Condition Assessments identify and target existing line segments in portions of the collection system that have broken pipelines and failed joints (i.e. structural deterioration / failure). Sanitary Sewer Assessments commonly include recommendations for reducing inflow and infiltration during wet weather events. These recommendations may include projects that a) replace and/or raise manhole lids that are in low areas where stormwater may pond, b) disconnect stormwater catch basins that are currently connected to the sanitary sewer system, and c) disconnect roof, sump, and foundation drains that are connected to the wastewater system in an effort to reduce inflow and infiltration.

It is not uncommon for collection system improvement (Sanitary Sewer Assessment) programs to be particularly costly. Additionally, the completed improvements may or may not have an immediate effect on significantly reducing peak flow rates. In some cases, the amount of reported flow reduction resulting from collection system rehabilitation was less than anticipated. In some unusual

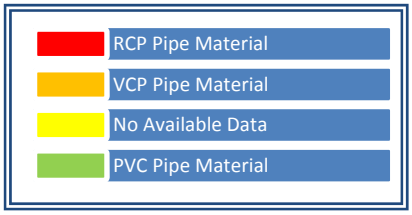
circumstances, flow rates have actually increased after the completion of the collection system improvement program.

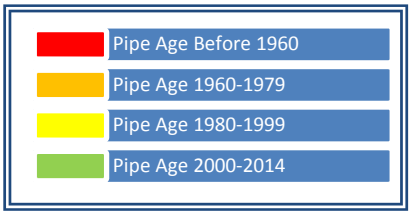
7.2. Risk Matrix

Risk Avoidance

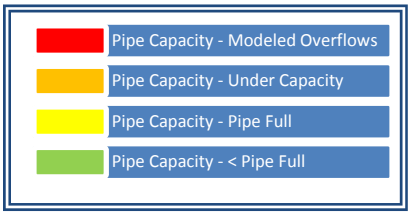


Structural Integrity





Hydraulic Capacity



The Risk Matrix is provided in Appendix C. The matrix was developed to assist in prioritizing the various identified projects utilizing a risk-based analysis. Each project was rated (scored) individually utilizing two types of scoring elements:

Traditional Engineering Elements

- Risk Avoidance – evaluation of pipe diameter. Larger size pipes received a higher score based on the higher risk entailed with a catastrophic failure.

- Structural Integrity – evaluation of pipe material, age, or pipe condition. Existing gravity lines to be replaced within an identified project that are made of a newer type of pipe (e.g. PVC) and were installed more recently received a lower score than those of an older type of pipe (e.g. VCP or RCP) that was installed at an earlier date. Projects that involve rehabilitating or replacing a force main received a score based on the current structural condition of the pipe based upon the Water Utilities staff knowledge. A mid-range score was given for segments that had no available data regarding pipe material or age in order to estimate as accurately as possible the general condition of the collection system.

- Hydraulic Capacity – evaluation of the pipe capacity and the volume of wastewater overflow based on the collection system model. Scores were assigned as a result of the modeled capacity and overflow volume during the 5-year, 6-hour design storm event.

Social, Political and Economic Elements:

- Effect on Public Safety – evaluation of a project's location in relation to public facilities, neighborhoods, and environmentally sensitive areas. Also taken into consideration was the ability of the project to reduce known maintenance problem areas and SSO's.

- Improvement for Economic Development / Redevelopment – evaluation of a project's impact on allowing for upstream development and on the reduction of peak flows downstream. Projects received higher scores if they provided more downstream capacity which allowed for more growth upstream or in downstream areas that could not be developed under the current conditions.

- Return on Investment – evaluation of a project's initial cost versus the working life of the updated system based on the improvements made and the difference in the maintenance costs resulting from the improved system.

- Sustainability – evaluation of a project's ability to reduce operational and maintenance costs on the current system. Projects received higher scores if they allowed for the abandonment or replacement of a lift station and the removal or replacement of pipe in recurring problem areas.

- Time to Implement or Construct – evaluation of a project's need for easement or right-of-way acquisition.

The projects identified in the risk matrix had a possible maximum overall project score of 85 points. The higher the score, the higher the risk to the City if not addressed. The order of the projects shown in the risk matrix does not completely correspond with the overall project score from highest to lowest due to the fact that additional issues exist that are not able to be fully considered within the matrix. These extra issues ultimately influence the final recommended prioritized ranking. One of the additional issues that significantly influenced the prioritized ranking was the timing of the various projects. The completion of one project may impact the subsequent completion of another project (predecessors & successors). This issue is addressed in Figure 8-50: Project Implementation Schedule (Page 8-93). The Project Implementation Schedule illustrates that even though one project may score higher than other projects in the risk matrix, it should not be initiated until the identified predecessor project has been completed. This is important due to the nature of several of the identified projects consisting of flow / basin reroutes and increases to lift station capacity. **This approach of using a risk matrix and project implementation schedule to rank projects, along with sound engineering judgment and historical knowledge of the collection system, results in the identification of a Capital Improvements Program that provides the greatest benefit to the City.**

7.3. Collection System Evaluations

The following specific collection system evaluations were performed as part of this engagement and were focused on identifying crucial elements requiring attention:

- Aerial Crossing and Siphon Evaluations
- Lift Station Abandonment Evaluations
- Mt. Carmel Backwash Filter Evaluation
- City of Beverly Hills Evaluation
- Future Interceptor Alignments, Lift Station, and WWTP Location Evaluations

Evaluations were founded on coordination efforts with Water Utilities staff. They were additionally built upon a spatial analysis, review of GIS / record drawings, and site visits to various collection system locations.

7.3.1. Aerial Crossing and Siphon Evaluations

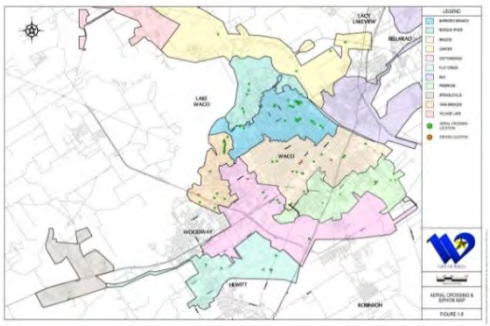


Figure 2-8: Aerial Crossing & Siphon Map (Page 2-35)

As a rule, existing aerial crossings within a collection system are considered to be potential areas of significant environmental risk. Therefore, removal or abandonment of these features is advantageous to a wastewater utility. Likewise, siphons have a higher frequency of recurring maintenance than standard gravity lines. Removal or abandonment of siphons generally provides benefits to a collection system.

A number of the existing aerial crossings are located in the vicinity of the identified Capital Improvement Program projects (both specific projects and “Asset Renewal” projects). **Section 8.4, Project Detail Descriptions 1-10 Yr. Projects** provides project maps that indicate the location(s) of the existing adjacent / nearby aerial crossings. As each project moves into its final design phase, it is recommended that further assessment be performed to determine if it is feasible for the nearby aerial crossings to either be removed or abandoned as part of the current project or that the proposed line be designed at such a grade that will allow the associated aerial crossing to be removed as part of a future project. The existing Aerial Crossing & Siphon Map (Figure 2-8) (Page 2-35), displays various aerial crossings within the City’s collection system. The final decision should be made while considering the current structural condition of the aerial crossing.

For aerial crossings that cannot be eliminated from the collection system due to design related reasons, it is recommended that Water Utilities staff continue to monitor these locations so that they can be incorporated as necessary within the various “Asset Renewal No. 2, 3, 4 and 5” projects. As an example, 13 of the 51 projects identified within the “Asset Renewal No. 1 Project” have existing aerial crossings that need to be replaced or removed (as identified by Water

Utilities staff). Many of these existing aerial crossings are comprised of ductile iron pipe that exhibits noteworthy structural deterioration.

7.3.2. Lift Station Abandonment Evaluations

As part of this evaluation, routing alternatives were developed that would facilitate the abandonment of various existing lift stations within the wastewater collection system. **City staff specifically requested that the Team investigate these opportunities due to the fact that the City currently owns and operates 58 lift stations within the collection system and that many of these stations are reaching the end of their design life.** Therefore, the City considers it crucial to identify stations that could be eliminated in the future. The City is interested in available options to address the aging lift stations. An objective of the evaluation was to lay out a "road map" that would allow for the overall reduction in the total number of lift stations within the current system. This in turn will reduce the accompanying long term operation and maintenance costs associated with pumps, motors, generators and electrical service. The evaluation considered topographic features, known physical obstacles, land uses, populations/flows (both current and projected) and other tangible items that were identified during the development of the various routing options.

18 existing lift stations were identified for future elimination consideration.

A total of 18 existing stations were identified for future elimination consideration. Of those, up to 9 stations can be potentially abandoned as part of the 1-10 Year Capital Improvement Program. **Theoretically, should each of the identified lift stations be abandoned over the next couple of decades, the City could eliminate approximately 25% of the total number of lift stations that are currently being operated and maintained.** From an overall planning goal, this is considered to be both a commendable and aggressive goal.

Lift station abandonment is a complex undertaking. The fundamental solutions at some of the stations are much more "straightforward" than at other locations. **A number of locations will require either relatively deep open cut construction or in some cases will require the use of directional drilling. The potential use of directional drilling for gravity sewer applications must be used with discretion. The consideration of drilling at very flat grades in order to obtain an ultimate gravity flow solution must be thoroughly analyzed on a case by case basis.** This case by case analysis is beyond the scope of a master planning effort and must be closely vetted in detail before moving forward.

As a general rule, the lift stations that have a larger pumping capacity and can be abandoned (eliminated) from the collection system are more likely to have a higher return on investment for the effort.

Some lift station abandonments would prove to have greater benefits for the City as compared to others. For some stations, it may make

sense to remain in service until they reach the end of their design life and then make a decision regarding rehabilitation or abandonment. Some of the locations that have been identified require predecessor projects, thereby not allowing them to be implemented until the corresponding predecessor project has been completed. Finally, some locations will reroute flow away from wastewater lines (and interceptors) that currently experience hydraulic capacity problems during wet weather events. The rerouting of these flows will assist in relieving these capacity problems.

Figure 7-1 provides a map of the various lift station abandonment projects that were identified within the above evaluation. Each of the identified locations can be seen in further detail on the individual lift station abandonment maps following Figure 7-1. At this time, the most common-sense lift stations to consider for abandonment in the near-term are the Village Lake, Flat Rock, Village Green, Chicken Shack, Lincoln Park, and McLennan County Jail lift stations.

THIS PAGE IS INTENTIONALLY LEFT BLANK

LEGEND

- Propsed Lift Station Abandonment/Gravity Extension
- (1) Ledgestone
- (2) Village Lake
- (3) Flat Rock
- (4) Falcon Pointe
- (5) Bosqueville, Avon, Mammoth Site, & Riverbend Ball Park
- (6) Parkview
- (7) Village Green
- (8) Lindsey Hollow, Cameron Park, Redwood Shelter, & Pecan Bottoms
- (9) Chicken Shack & Lincoln Park
- (10) McLennan County Jail
- (11) FM 434
- (1) Carver (WMARSS)
- Surface Water
- Stream
- Waco City Limits
- WacoETJ

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

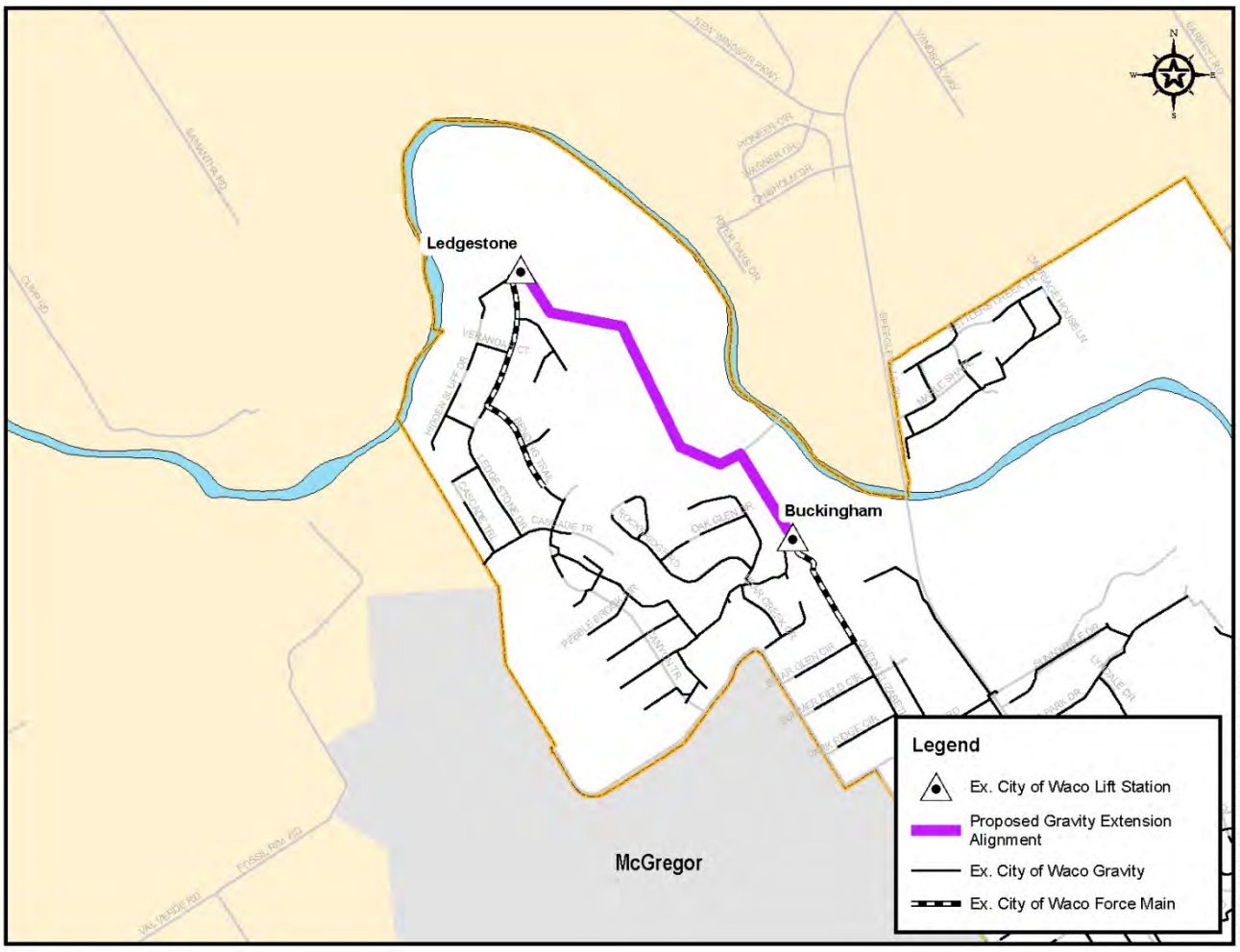
Figure 7-1: Lift Station Abandonment and Gravity Extension Map

G:\GIS\Projects\1-02231\Maps\Tech Memo 8 - Overall LS Maps.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

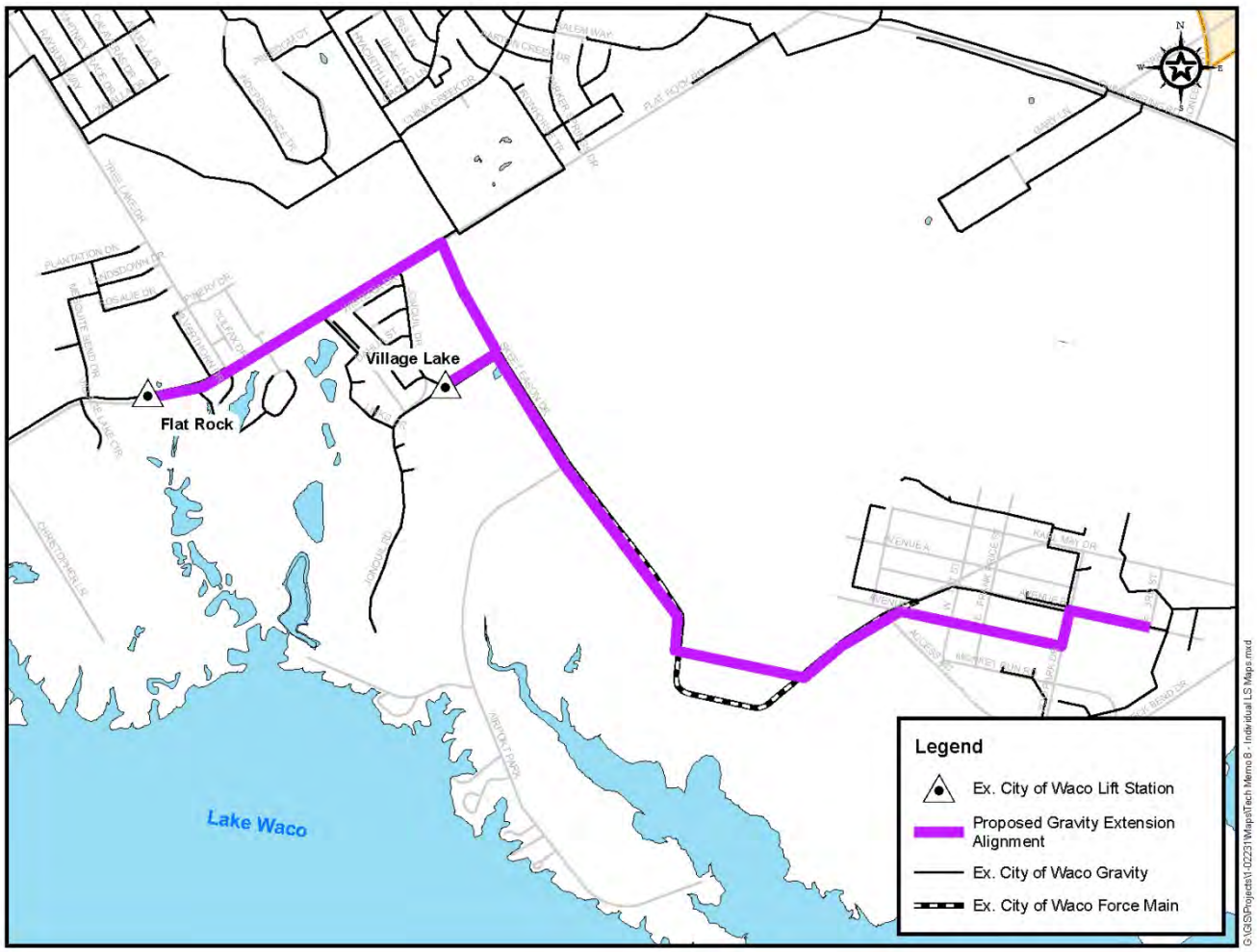
1. **Ledgestone Lift Station** – This lift station was constructed within the last 10 years, but it is possible for this station to be abandoned and replaced with a gravity extension in the future. Not regarded as a high priority alternative (option), but record drawings indicate an approximate elevation difference of 15' from the existing upstream to downstream flow lines that would accommodate this abandonment.

Figure 7-2: Ledgestone Lift Station Abandonment Map



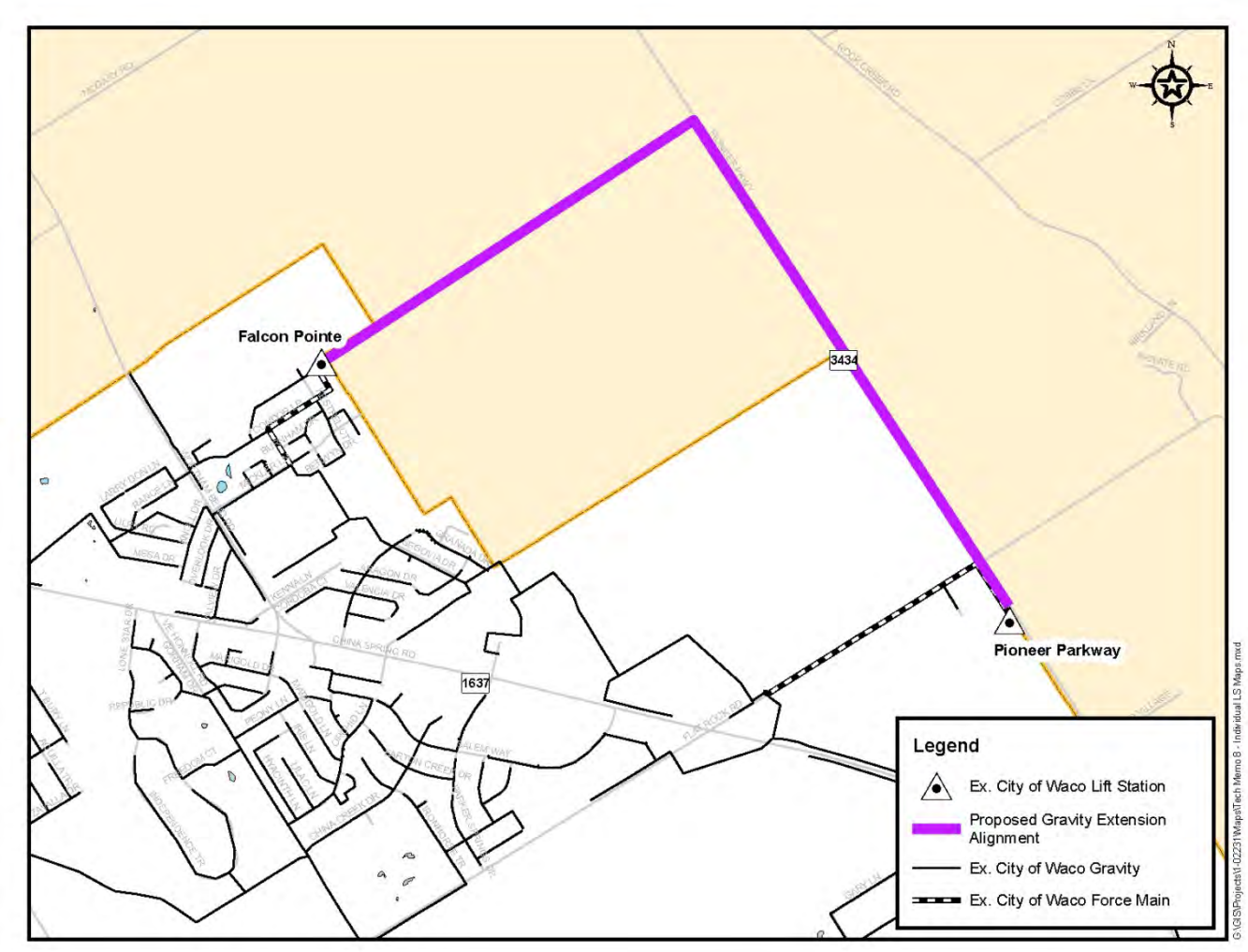
2. **Village Lake Lift Station (1-10 Yr. CIP) and Flat Rock Lift Station (11-21 Yr. CIP) –** See Sections 8.4 & 8.5 for detailed project descriptions of both projects. The existing stations are located in areas that have experienced high growth over the last 10 years and it is envisioned that this area will continue to experience meaningful growth in population over the projected planning period. The existing Village Lake Lift Station has an elevation head of approximately 34 ft. while the existing Flat Rock Lift Station has an elevation head of approximately 30 ft. One challenging aspect to this potential abandonment is the need to either cross underneath the Waco Regional Airport runway with a long bore or along Skeet Eason Road in a deep cut installation with limited working space.

Figure 7-3: Village Lake Lift Station Abandonment Map



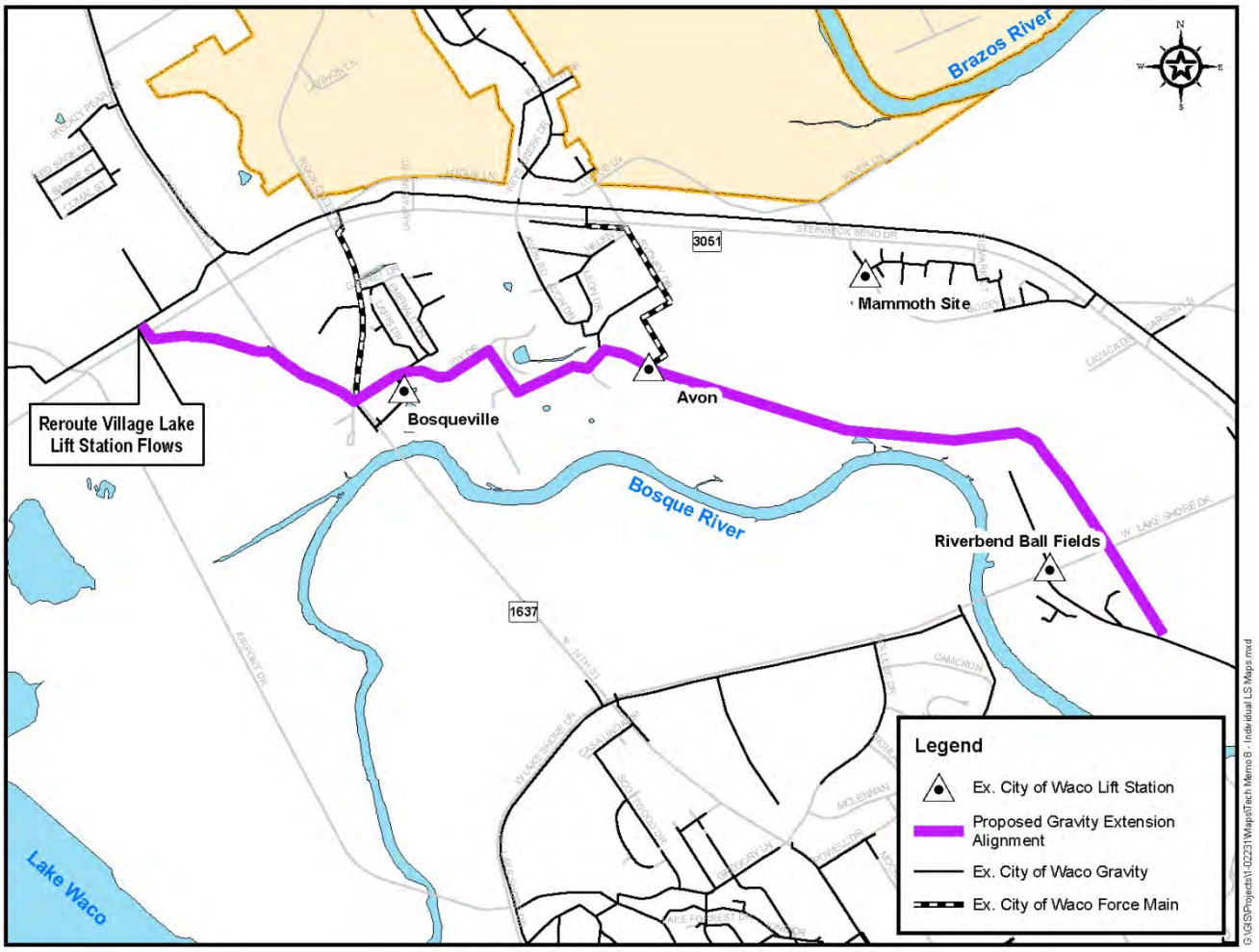
3. **Falcon Pointe Lift Station** – Should the City expand the City limits in the area north of the current Falcon Pointe subdivision, it is envisioned that the existing station can be abandoned and replaced with a gravity extension and tie into the existing gravity line on FM 3434. At this time, the line extends outside the current City limits. Associated improvements will also be required with both the Pioneer Parkway lift station and force main. The proposed project would reroute flows in virtually the opposite direction as the current flow routing.

Figure 7-4: Falcon Pointe Lift Station Abandonment Map



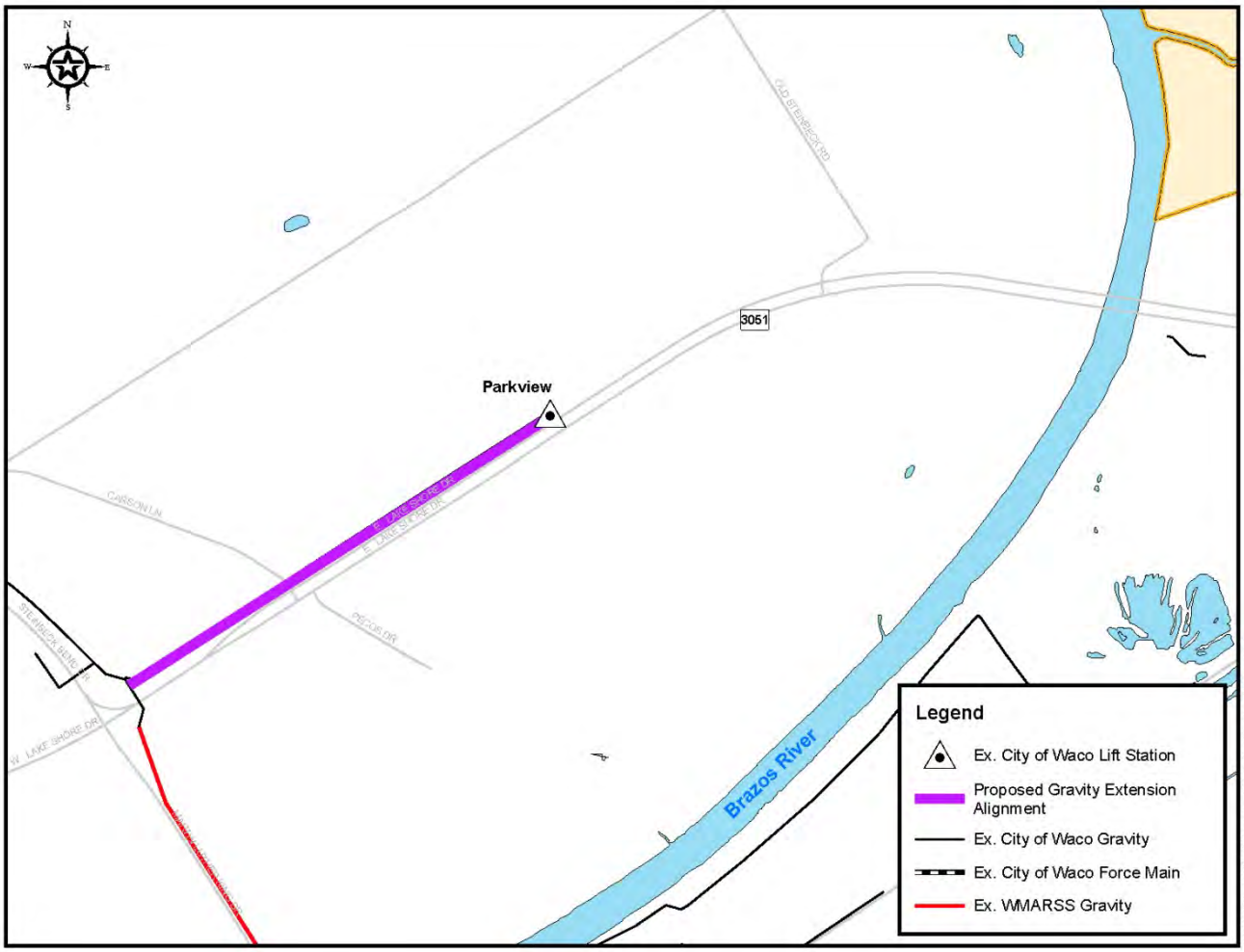
4. **Bosqueville, Avon, Mammoth Site and Riverbend Lift Stations (11-21 Yr. CIP)** – This abandonment was identified to be triggered by growth / flows at the time that the 21-inch wastewater line along Steinbeck Bend Drive has exceeded its available hydraulic capacity. This project would route the Village Lake Lift Station flows to the south of the existing gravity sewer along Steinbeck Bend, while at the same time allow for the abandonment of four existing lift stations. The existing gravity sewer along Steinbeck Bend has capacity and would continue to convey the remaining flows.

Figure 7-5: Bosqueville, Avon, Mammoth Site and Riverbend Ball Fields Lift Station Abandonment Map



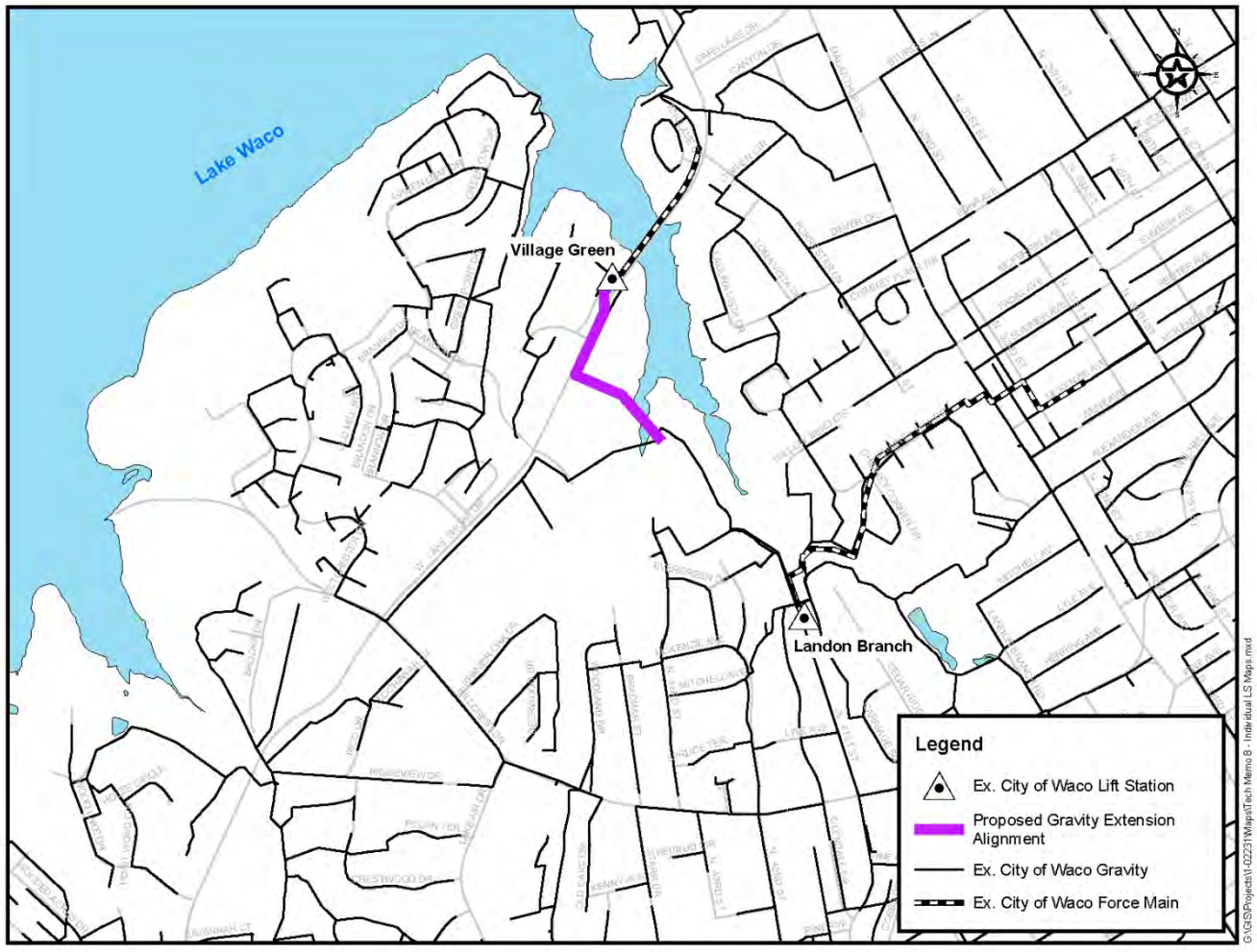
5. **Parkview Lift Station** – The abandonment of this lift station would require a predecessor project. The City should evaluate the potential abandonment of the Parkview Lift Station at such time that additional WMARSS East Bank Interceptor hydraulic capacity is required or replacement of the existing interceptor is warranted. The flow line of the WMARSS East Bank Interceptor will need to be lowered to accommodate the abandonment of the station and the associated gravity sewer service.

Figure 7-6: Parkview Lift Station Abandonment Map



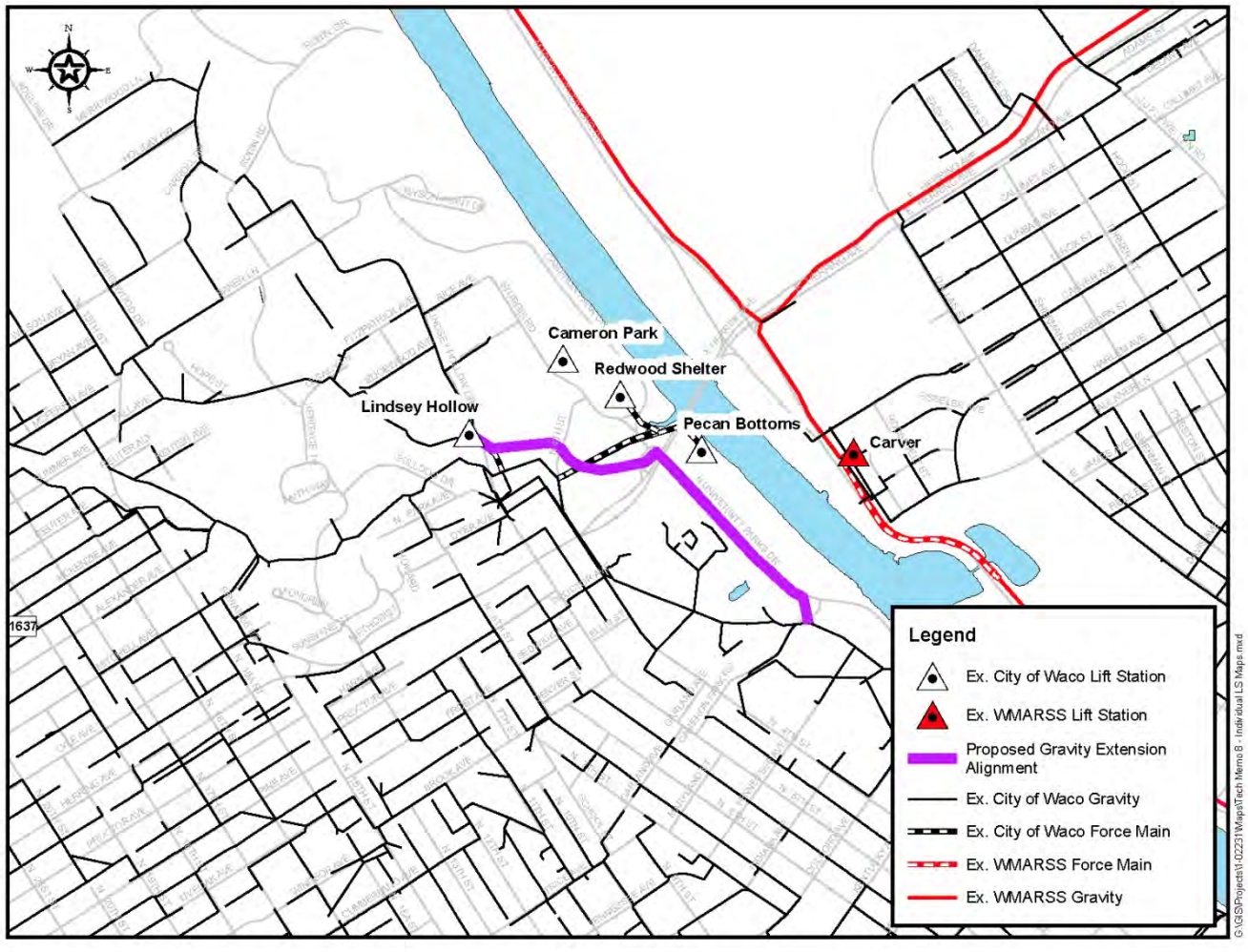
6. **Village Green Lift Station –** The abandonment of this lift station would not only feature the benefits discussed previously, but would also provide the added benefit of rerouting flows from the WMARSS East Bank Interceptor to the proposed Landon Branch Lift Station and the proposed Brazos Interceptor. Refer to Section 8.4 for a detailed description of the Brazos Basin Interceptor project (included within the 1-10 Year Capital Improvement Program). The timing of this project must be coordinated with a number of additional projects that are included within the Capital Improvement Program Project Implementation Schedule.

Figure 7-7: Village Green Lift Station Abandonment Map



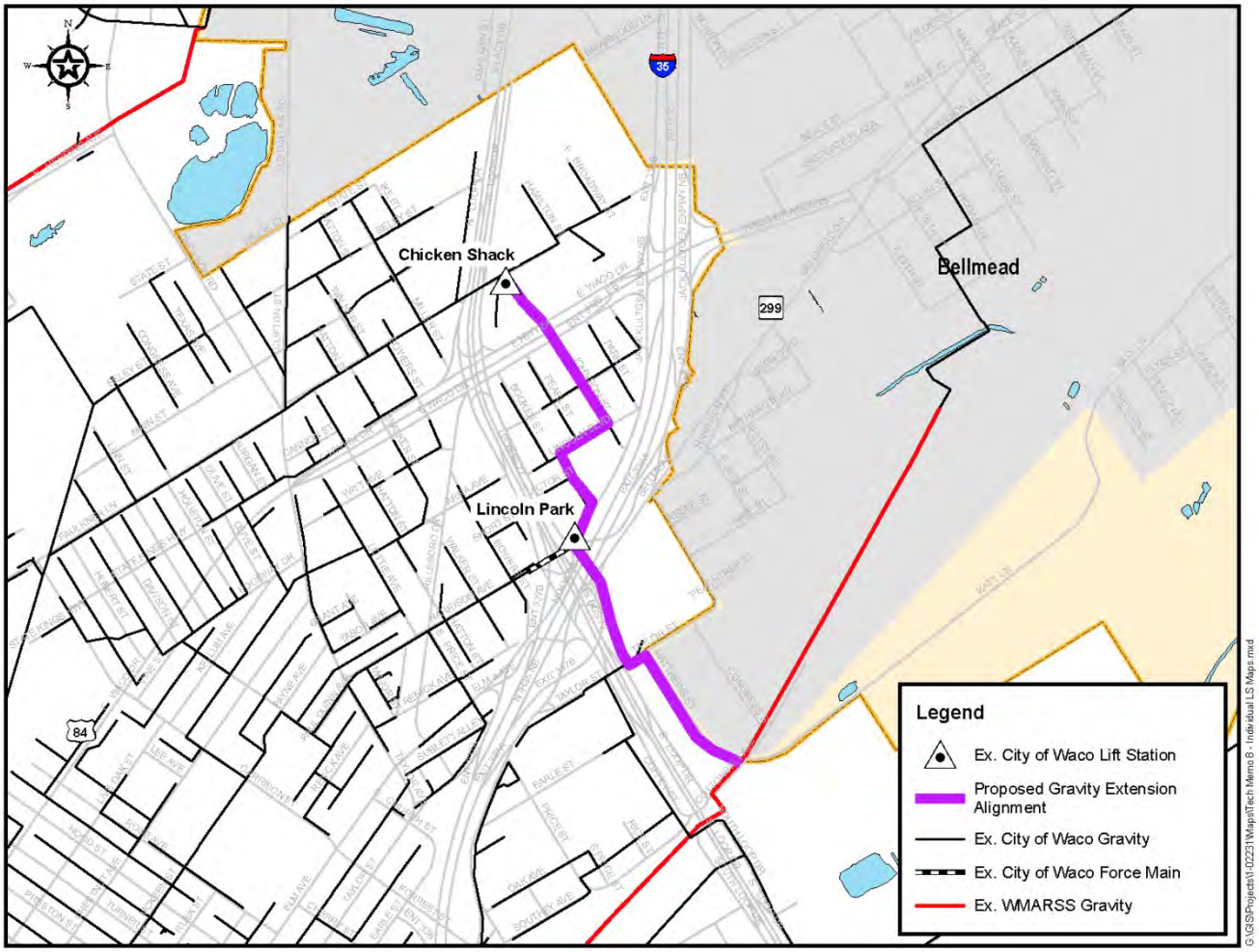
7. **Lindsey Hollow Lift Station –** This project could possibly include Cameron Park, Redwood Shelter, and Pecan Bottoms Lift Stations. This project is identified within the 1-10 Year Capital Improvement Program. See Section 8.4 for a detailed description of the project. Flows would be discharged into the West Bank Interceptor downstream of the Cameron Park Zoo. Portions of this project would likely require trenchless construction techniques below the highly wooded areas north of Herring Avenue.

Figure 7-8: Lindsey Hollow Lift Station Abandonment Map



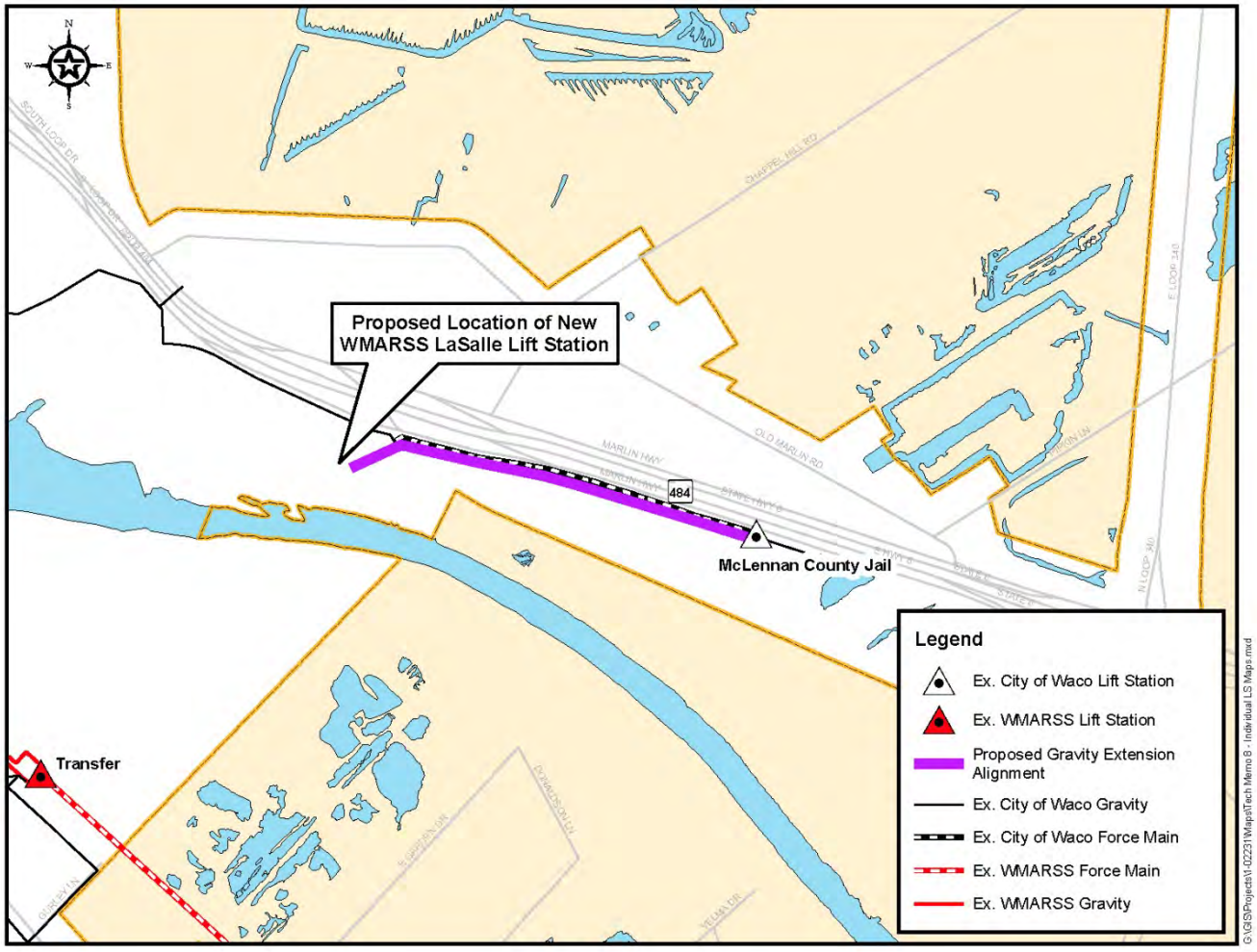
8. **Lincoln Park and Chicken Shack Lift Stations** – Refer to Section 8.5 for additional description of the project. Before this project can move forward, several predecessor projects will need to be completed. The final route alignment will require a bore under IH-35. The biggest benefit is that the project will reroute flow away from the WMARSS East Bank interceptor (and other upstream lines that are capacity limited) to the WMARSS Bellmead Interceptor. The existing Lincoln Park Lift Station has an elevation head of approximately 6 ft. while the existing Chicken Shack Lift Station has an elevation head of approximately 3 ft.

Figure 7-9: Lincoln Park and Chicken Shack Lift Station Abandonment Map



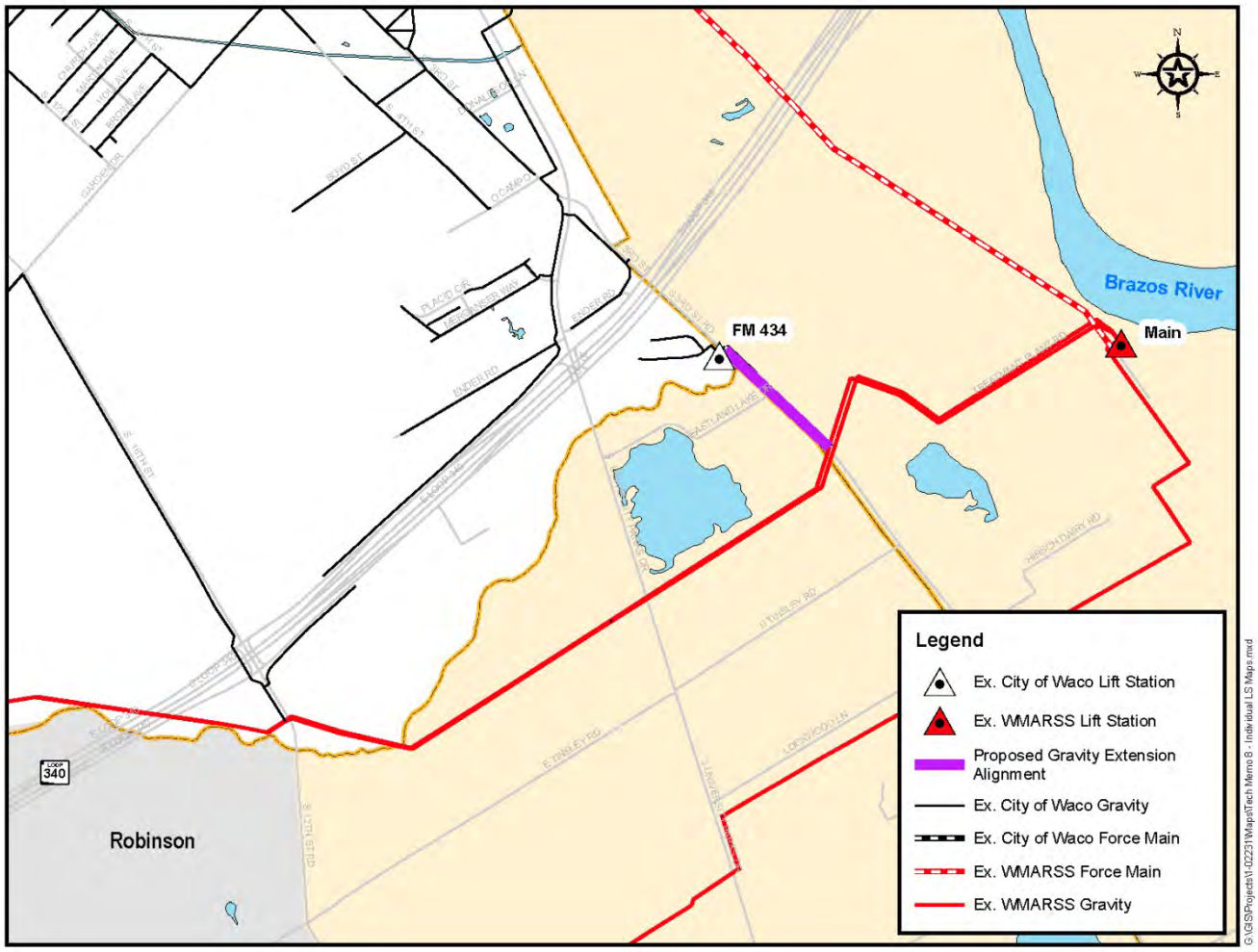
9. **McLennan County Jail Lift Station** – This project is identified within the 1-10 Year Capital Improvement Program. Refer to Section 8.4 for a detailed description of the project. This project can be initiated any time after the WMARSS LaSalle Lift Station Relocation project is completed. The existing McLennan County Jail Lift Station has an elevation head of approximately 12-ft.

Figure 7-10: McLennan County Jail Lift Station Abandonment Map



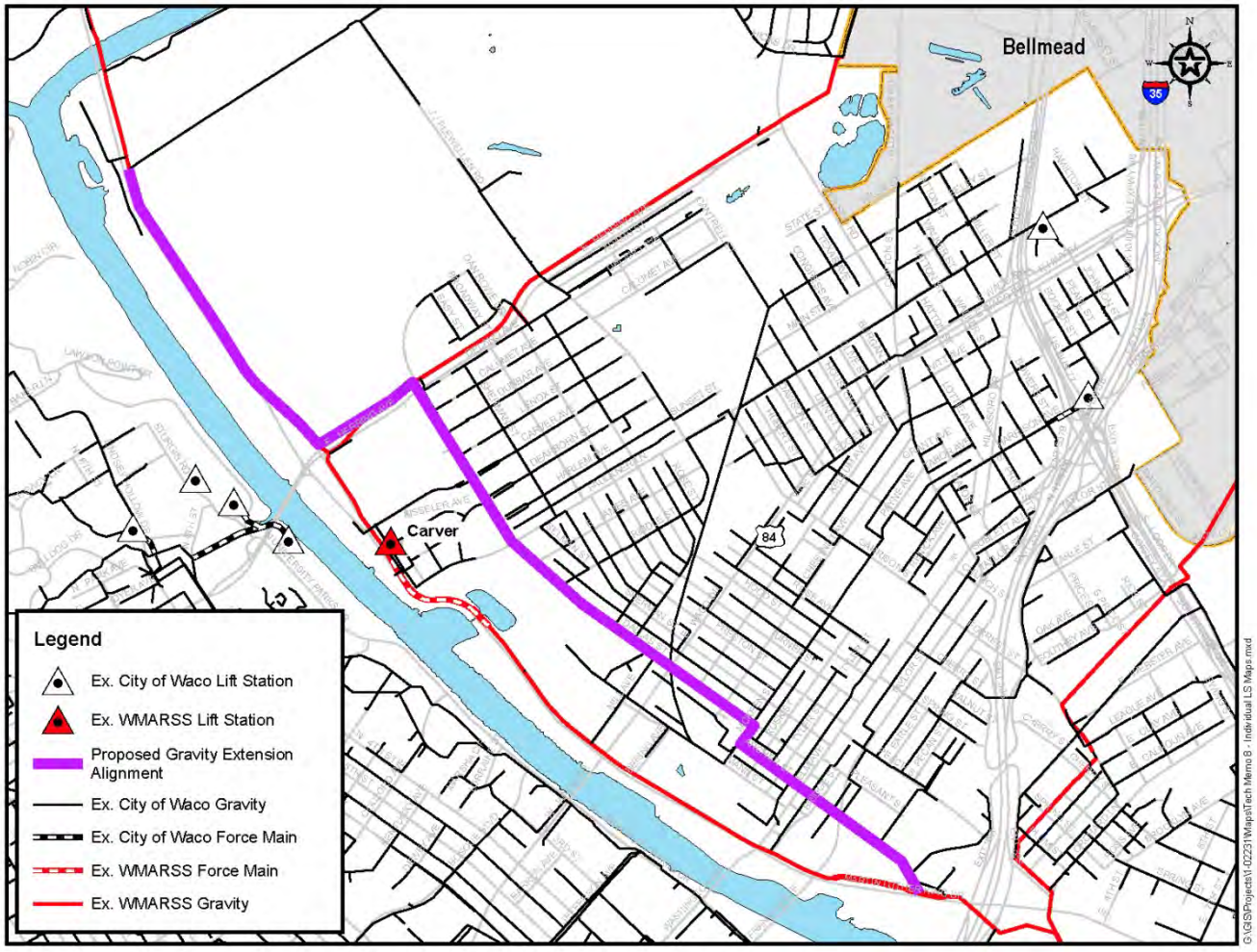
10. **FM 434 Lift Station** – The abandonment of this lift station cannot be accomplished until a predecessor project on the WMARSS Cottonwood Creek Interceptor is completed. The City should evaluate the potential of abandoning the FM 434 Lift Station at such time that the WMARSS Cottonwood Creek Interceptor is replaced. The Cottonwood Creek interceptor project is identified as a project within the 1-10 Year Capital Improvement Program. The flow line of the WMARSS Cottonwood Creek Interceptor will need to be lowered to accommodate gravity sewer service from the existing FM 434 Lift Station site. The existing FM 434 Lift Station has an elevation head of approximately 10 ft. The FM 434 lift station was constructed in 2005 and is not currently a high priority for abandonment.

Figure 7-11: FM 434 Lift Station Abandonment Map



11. **WMARSS Carver Lift Station** – In addition to the above referenced City of Waco lift station abandonments, this WMARSS lift station was identified for consideration for future lift station abandonment. The existing Carver Lift Station only has an elevation head of approximately 20 ft. City of Waco Water Utilities and WMARSS staff have discussed for years the future need of replacing (removing) the existing siphon lines located on the Brazos River with a new lift station and force main north of the River. The existing Carver lift station could be replaced with a new lift station on the north side of the River upstream of the existing siphon lines and the installation of a deep gravity interceptor downstream.

Figure 7-12: Carver Lift Station Abandonment Map



7.3.3. Mt. Carmel Backwash Filter Evaluation

The City currently discharges approximately 375,000 to 500,000 gallons of reject water per day into the City's wastewater collection system to be treated at the WMARSS Central Plant.

The Mt. Carmel Backwash Filter is located at the Mt. Carmel Water Treatment Plant. Over the course of the last 15 years, the plant has discharged its reject water into the City's wastewater collection system. Currently, the City discharges approximately 375,000 to 500,000 gallons of reject water per day (260 gpm to 350 gpm) into the City's wastewater collection system to be treated at the WMARSS Central Plant. **The Central Plant is located over nine miles away from the Mt. Carmel Water Treatment Plant. This flow is currently routed through multiple gravity lines and force main segments as well as three lift stations (City of Waco Wooded Acres Lift Station, the WMARSS Woodway Lift Station and finally the WMARSS Main Lift Station). The transmission of these daily flows amounts to a substantial annual operation and maintenance commitment.** Many of the facilities that currently transport the reject water are hydraulically overloaded or are in poor structural condition. The removal of this substantial wastewater generator from the collection system will generate some much needed relief for the system.

Up until approximately 15 years ago, the Mt. Carmel Water Treatment Plant discharged its reject water back into Lake Waco. **As a result of increasingly restrictive regulatory requirements regarding reject water and due to the fact that the City was dosing very high rates of activated carbon to address taste and odor issues, the City made the decision to discontinue discharging into the lake and to begin conveying the reject water to the wastewater collection system for treatment at the Central Plant.** However, after the completion of the Dissolved Air Flotation (DAF) Plant, the City is now able to treat the water differently and therefore the resulting chemical loading in the backwash water is much lower (the DAF now removes both the algae as well as other suspended particles from the raw water supply). Due to these changes that have occurred within the last 5 years, the City may now want to re-examine their current practice. A couple of potential alternatives may include: 1) discharging the effluent back into Lake Waco after it has been treated (filter), or 2) treating (filtering) the effluent and then recirculate / reintroduce the filtered flow back at the influent point of the Mt. Carmel Water Treatment Plant. City personnel conveyed that other viable potential backwash alternatives have not been considered since the DAF Plant was brought online. **There is enough evidence to support alternate uses for the reject water to recommend the City undertake a feasibility study to determine if there is a more beneficial use for the reject water.** Reuse water continues to become increasingly important in our State. In any case, the City could recognize a cost savings by determining a method to avoid introducing such a large consistent base flow into the already critically overloaded wastewater system. Holistically, there appears to be real potential benefits of discharging above the Lake Waco intake structure as compared to discharging at the WMARSS Central Wastewater Treatment Plant outfall at the Brazos River.

7.3.4. City of Beverly Hills

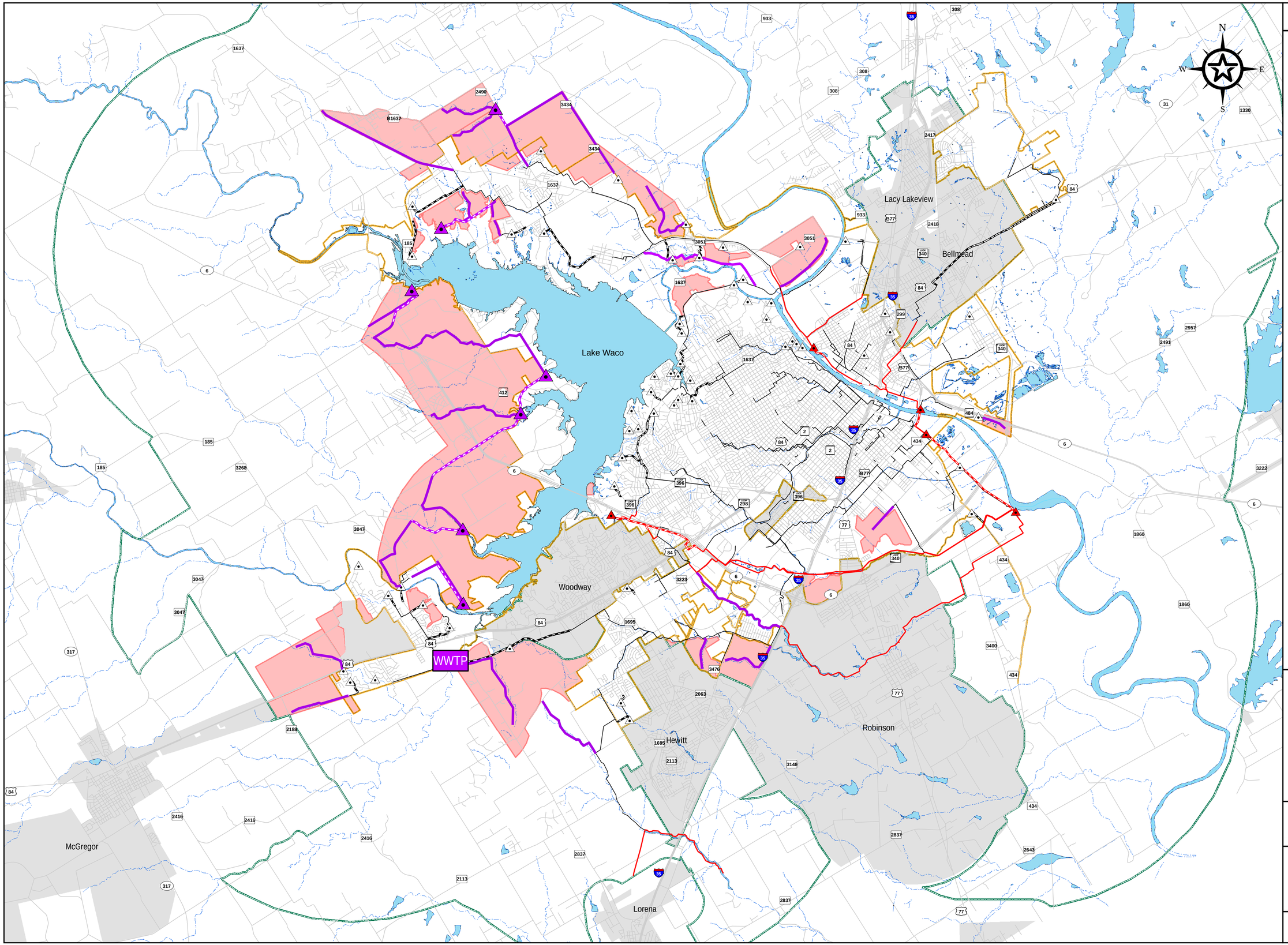
The City limits of the City of Beverly Hills is completely surrounded by the City of Waco. Waco provides both water and wastewater service to the citizens of Beverly Hills. Currently, the City of Beverly Hills has no requirement to coordinate with the City of Waco Utilities or Engineering regarding development issues within their City limits. The evaluation of structural and capacity related issues within the City of Beverly Hills was performed at the same level as they were within Waco's City limits. The Beverly Hills City limits are located within portions of the Cottonwood, Brazos, and Primrose Major Wastewater Basins. As previously discussed, a large percentage of the existing gravity sewers within these basins are considered to be greater than 50 years old and in poor to very poor structural condition**. It is recommended that the two Cities develop a formal process to make future coordination efforts more efficient and ensure adequate planning is accomplished**.

A formal coordination process would help in minimizing future obstacles such as locating structures over existing gravity sewers that are not located in easements. A significant number of the seasoned employees within both Waco and Beverly Hills have retired in the last several years. Therefore, the long-term institutional knowledge component is no longer in place.

7.3.5. Future Interceptor Alignments, Lift Station and WWTP Locations

Figure 7-13 provides a schematic map identifying proposed future collection system extensions and additions (with general project limits of future wastewater line alignments) that will allow additional future service and hydraulic capacity within the areas that the Waco Planning Department envisions as growth areas over the next 25 years (refer to Figure 3-1: 2040 Wastewater Service Envelope) (Page 3-3). **Future gravity sewers, lift stations and force mains are situated to provide a general plan that illustrates how public sewer service can be provided to areas that are currently unserved**. It is envisioned that a majority of these projects will be development driven projects with the developer responsible for portions of the cost. A majority of the future service areas are located outside the City's current city limits and are located within the Waco ETJ. Over the last 25 years the City has experienced its highest growth in the China Spring (Village Lake and Carver Basins) and along West US 84 (Speegleville Basin). This pattern is projected to continue over the next 25 years. The assets shown are based upon future projected growth and do not represent assets that are currently hydraulically challenged. The Team recommends that any new gravity sewers be designed so that the pipe will be flowing at 80% of pipe capacity at calculated future peak wet weather flows. This is a design standard that is common among municipalities including the City of Austin.

THIS PAGE IS INTENTIONALLY LEFT BLANK



LEGEND

- Future Service Areas
- Proposed Lift Station
- Ex. City of Waco Lift Station
- Ex. WMARSS Lift Station
- Proposed Gravity Sewer
- Proposed Force Main
- Existing City of Waco Gravity Sewer
- Existing City of Waco Force Main
- Existing WMARSS Gravity Sewer
- Existing WMARSS Force Main
- Stream
- Surface Water
- Waco City Limits
- Waco ETJ

CITY OF WACO

0 2,500 5,000 10,000
Graphic Scale (Feet)

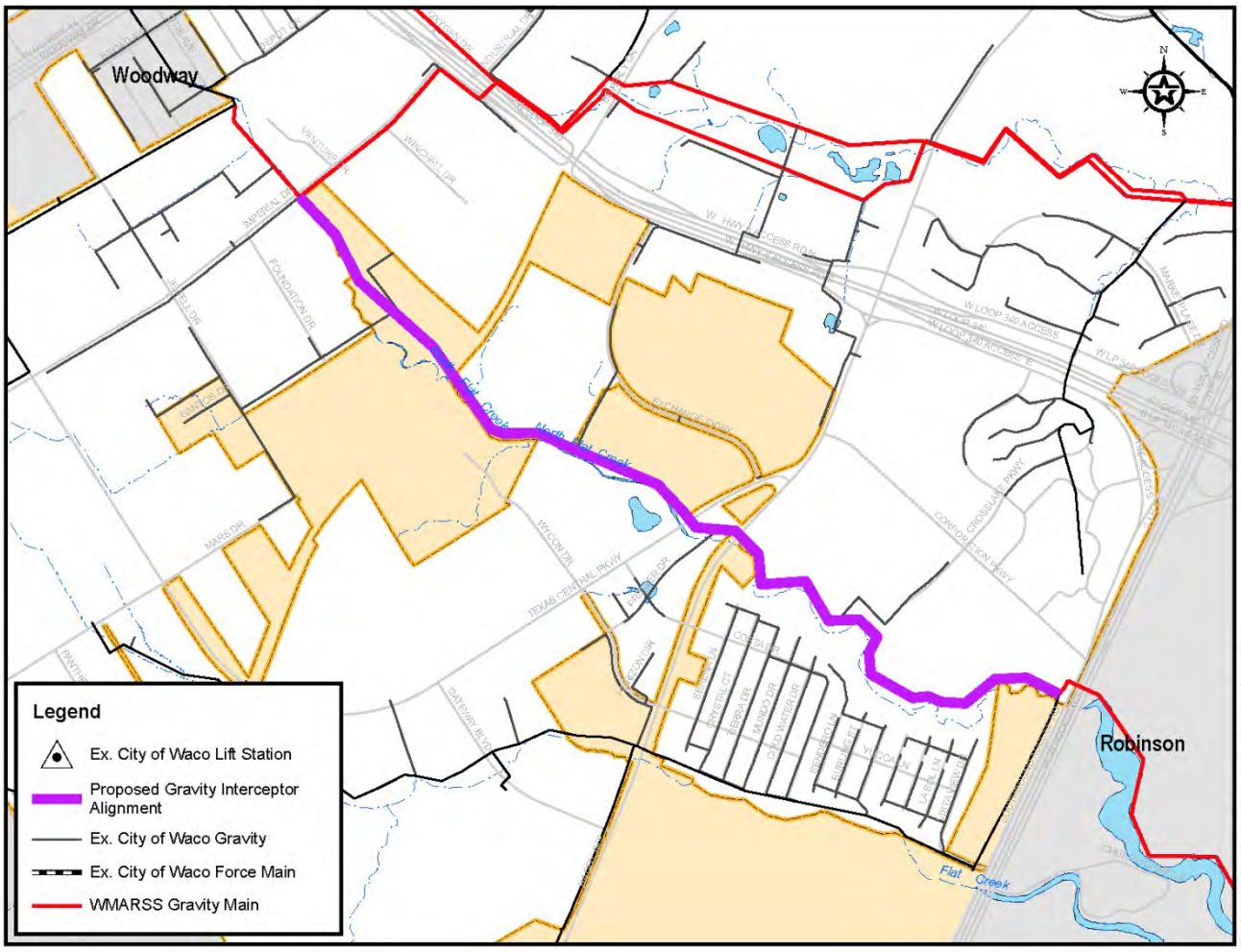
Figure 7-13: Future Service Area Map

G:\GIS\Projects\1-02231\Maps\Future Growth Area Map.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

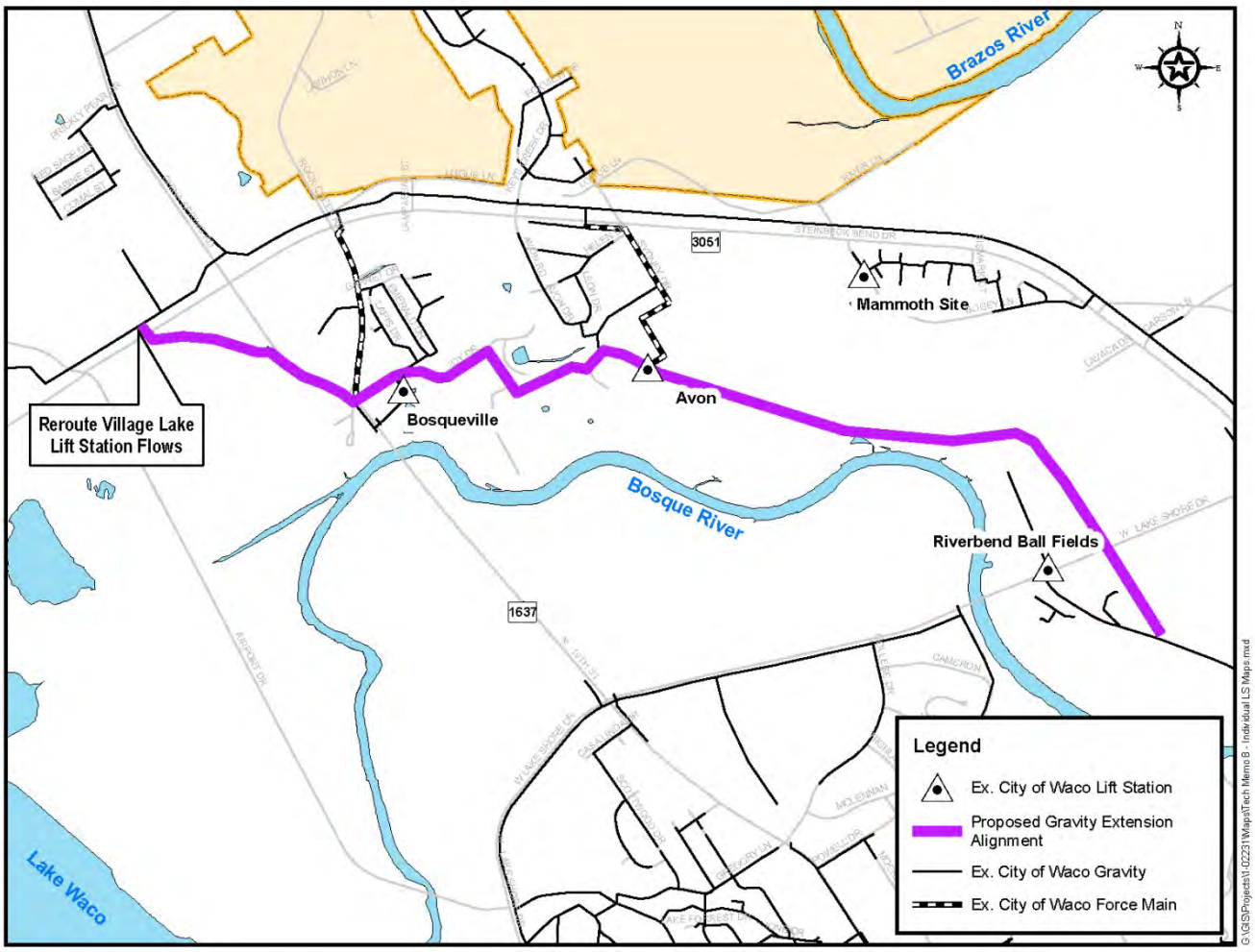
1. **Flat Creek Basin** – Future WMARSS interceptor extension project to accommodate growth in the Flat Creek, Cottonwood, and Twin Bridges Wastewater Basins.

Figure 7-14: Flat Creek Interceptor Extension



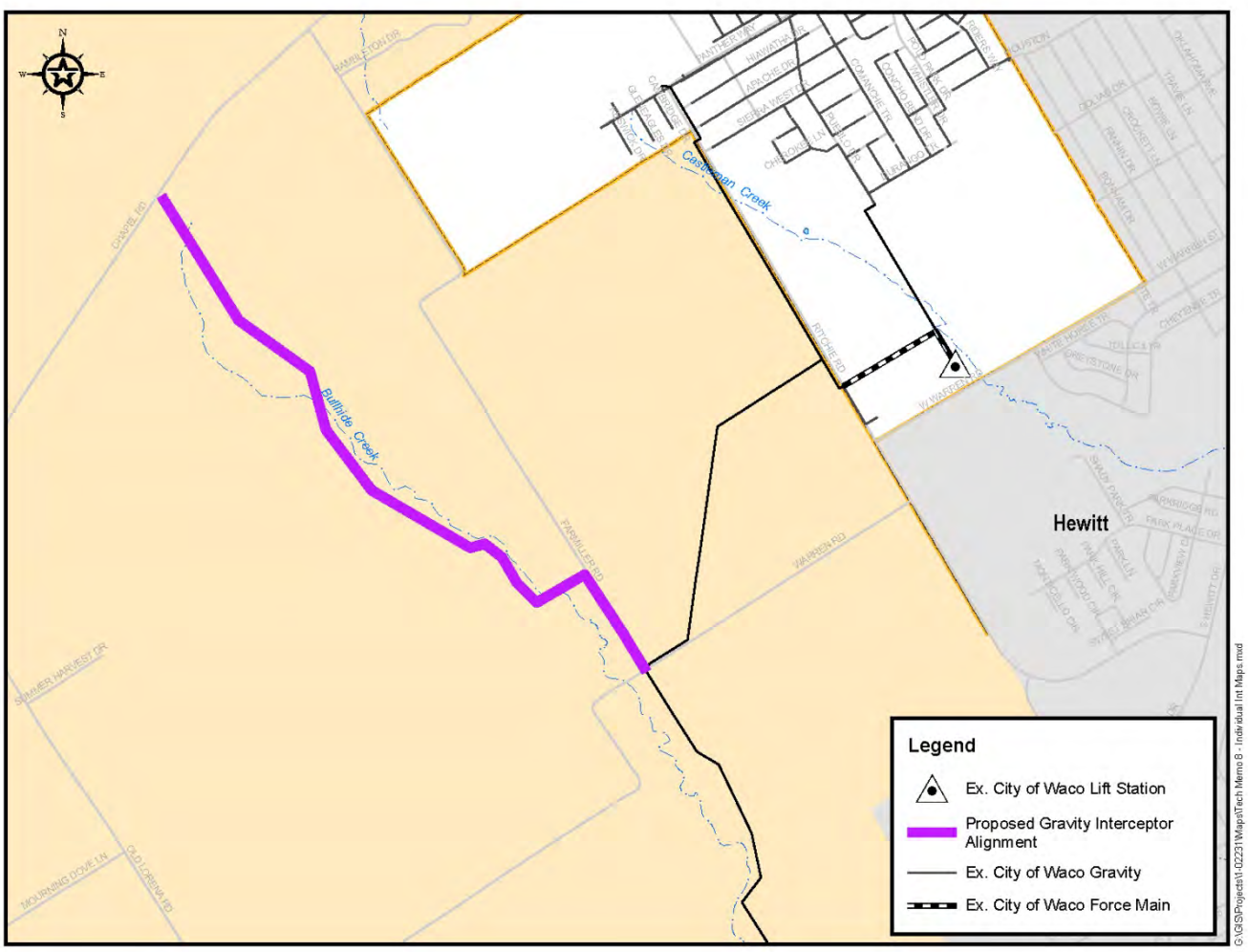
2. **Village Lake Basin** –Interceptor extension from Steinbeck Bend to near Hawaiian Falls Water Park for future growth in the Village Lake and Carver Wastewater Basins.

Figure 7-15: Village Lake Interceptor Extension



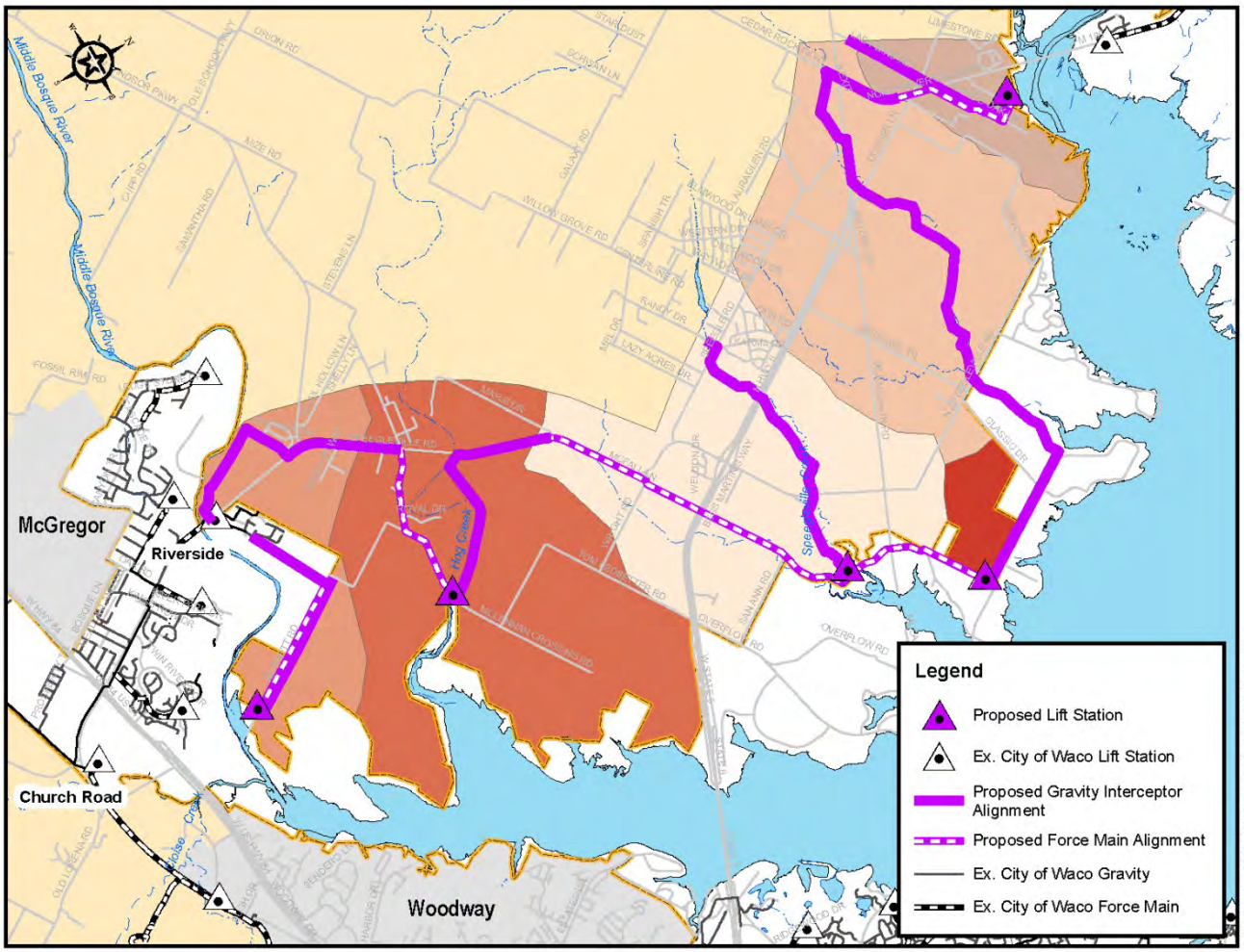
3. **Castleman Creek Basin** – Castleman Creek / Bull Hide Creek Extension for future growth in the Bull Hide Creek Wastewater Basin.

Figure 7-16: Bull Hide Creek Interceptor Extension



4. **Speegleville Basin** – Future growth in the Speegleville Wastewater Basin will need to be planned carefully in order to provide the best functioning wastewater collection system for the City and its residents in this area. A network of multiple gravity interceptors, lift stations and force mains is likely along with the possibility of satellite wastewater treatment plants.

Figure 7-17: Speegleville Basin Future Improvements



One potential treatment option is locating a scalping plant near the Church Road Lift Station Site. Daily Average Flow at the Church Road Lift Station is approximately 0.5 MGD. The peak wet weather flow at Church Road Lift Station is approximately 1.5 – 3.0 MGD.

It is projected that the Speegleville Basin will be one of the fastest growing basins over the next couple of decades. Also, the potential addition of City of McGregor flows (for future growth as well as growth in the Middle Bosque River and South Bosque River drainage basins) could influence what facilities are required. Based upon the actual future growth rates, it appears that at some point in time the possibility of sighting a scalping plant near the existing Church Road Lift Station site makes sense. The current Church Road Lift Station is located over 13 miles away from the WMARSS Central Plant and is affected by a topographic elevation difference of greater than 220 vertical feet. Additionally, the Speegleville Basin is located over 10 miles away from the City of Waco Mt. Carmel Water Treatment Plant resulting in potable water that has to be pumped through three different City of Waco pressure planes (PP 3, PP 4 and PP 6). The City has significant infrastructure in place (and planned for the future) to be able to supply adequate water and wastewater service to this portion of the City.

The City of Waco did not provide public sewer service within the Speegleville Basin until 2000. Over the course of the last 14 years, it has grown to serve a residential population of over 3,900 people. The future Speegleville Basin is projected to grow at an average annual rate of approximately 2.2% per year. This is consistent with the recent historical growth trends within the west US 84 corridor. The proper timing (need) for a scalping plant will be important and any Waco and McGregor negotiations regarding future conveyance and treatment will weigh heavily on the eventual timing of such a facility.

The reuse from the Speegleville Basin can potentially be discharged into one or more of the following three locations:

- Lake Waco (to allow for City's reuse and not discharge downstream of City where flows cannot be reused)
- Twin Rivers Golf Course
- City of Waco Landfill

Decentralized scalping plants (water reclamation plants) are an emerging alternative for treatment in areas where water reuse is becoming more and more critical. These plants are gaining attention because water purveyors and the general public are becoming aware that water is increasingly becoming a scarce resource. Therefore, municipalities are progressively evaluating the feasibility of constructing scalping plants to withdraw wastewater from a trunk sewer in order to produce reclaimed water and then return the bio-solids and non-reclaimable wastewater, such as brine, to the trunk sewer. The wastewater that is withdrawn from the trunk sewer is treated to specific limits depending on how the water is planned to be

used for beneficial reuse (i.e parks, golf courses, etc.) and reuse it so the area reduces its dependency on imported potable water. These plants can provide recycled water to areas without the extensive pipeline and energy / maintenance costs associated with pumping both water and wastewater for long distances. The remote facilities are typically sited upstream of wastewater treatment plants and are sited near the end users of the reclaimed water thereby reducing the associated transmission costs. Public perception has been a big issue over the years in water reuse, but it is improving. A proposed plant near the existing Church Road Lift Station could provide transmission of reuse water to the Lake, the Twin Rivers Golf Course, or the COW Landfill at a maximum distance of 1.5 miles. This is substantially closer than the current system configuration (13 miles and 10 miles). Additionally, providing recycled water into the upper limits of Lake Waco will allow the City to reuse this water. This is currently not the situation since wastewater flows generated within the Speegleville Basin are routed to the WMARSS Central Plant, treated and released back into the Brazos River below the City's water source.

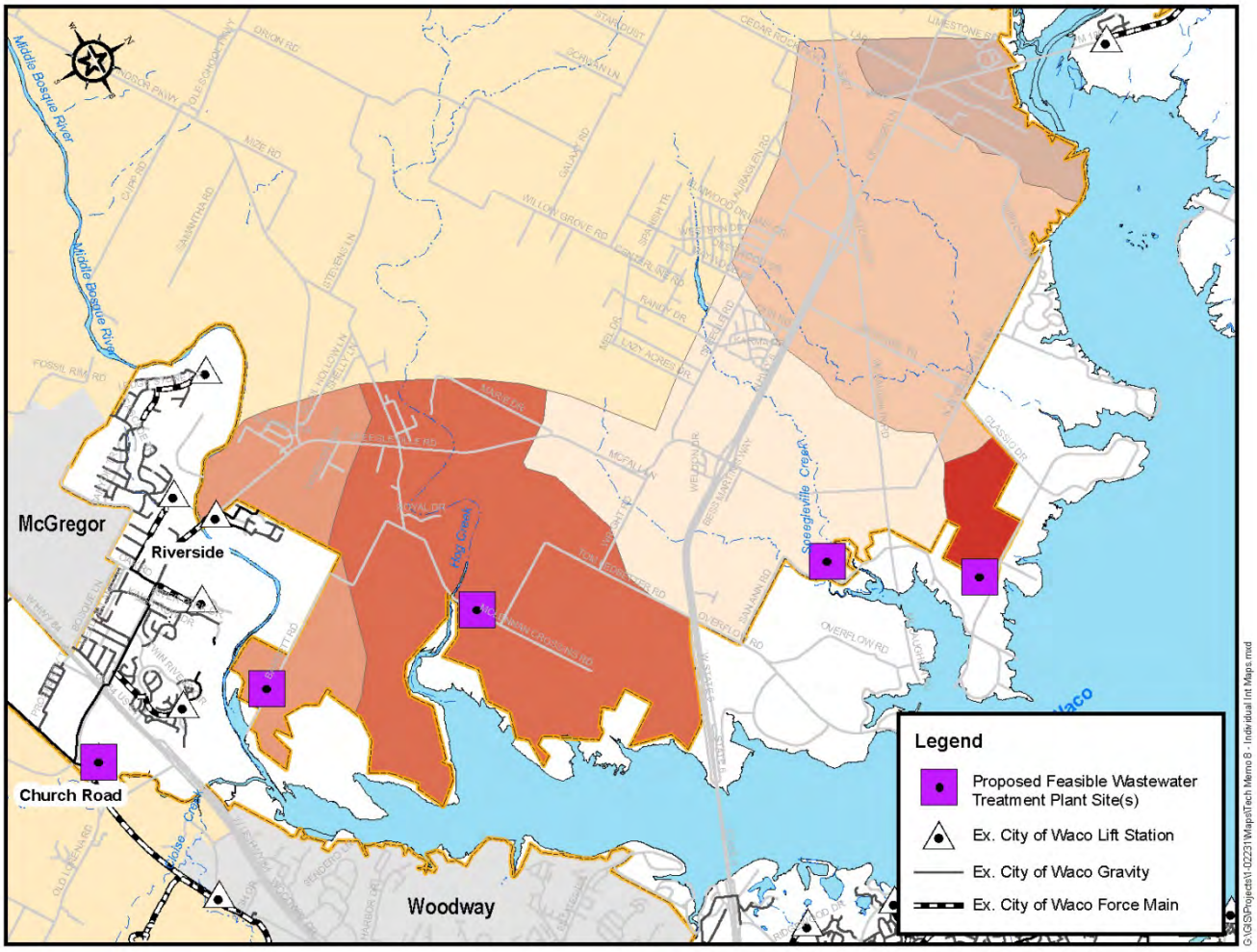
Generally, scalping plants require much less space as compared to traditional wastewater and water treatment plants primarily because they do not require the solids handling that traditional wastewater treatment plants do. The number one design consideration to be taken into account is to locate the plant in a hydraulically practical location close to the point of water reuse so that the pumping costs and additional infrastructure (piping, etc.) is economically feasible. The volume of flows will be of great concern since adequate flow must be available in the sewer to deliver the amount of reused water to the end customers.

On the wastewater collection side, the facility must be able to keep the solids returned to the sewer in suspension to avoid deposition and potential pipe restriction or plugging. On the recycled water side, the baseline flow must meet recycled water demands, to determine if additional storage or equalization will be required. Generally speaking, the current average daily flow is approximately 0.5 MGD. Usually treatment plants of 1 MGD or larger are much more cost effective than smaller plants. Therefore, waiting until additional growth occurs is judicious at this point.

Additionally, the Bull Hide Treatment plant is designed to accommodate an ultimate 12 MGD 2-hr peak flow. The infrastructure to the plant is sized to accommodate this volume. At the time that this threshold is met in the future, (Waco/WMARSS) will have to make the decision of increasing the capacity of the Bull Hide plant (and corresponding pipeline facilities) against siting a treatment plant within the general area of the Church Road Lift Station site. In 2013 Waco staff chose to move forward with designing the City of Waco Bull Hide Creek and Castleman Creek interceptor to have capacity for a peak wet weather flow of 3 MGD (2,083 gpm) at the Ritchie Road / Panther

Way intersection. Therefore, the Church Road Lift Station (when flows are rerouted) cannot exceed this peak flow volume.

Figure 7-18: Speegleville Basin Potential WWTP Locations



7.3.6. Flow-Equalization Facilities Evaluation

WMARSS and the City of Waco have evaluated the siting of potential equalization facilities within the collection system on numerous occasions.

Flow-equalization facilities are commonly recommended during planning efforts to provide peak flow storage either within the collection system or at the treatment plant as an effective measure in reducing peak flow rates at the WWTP. The siting of potential equalization facilities within the collection system has been previously evaluated by WMARSS and the City of Waco on more than one occasion. **The City of Waco has had a vested interest in this item because virtually all of the original WMARSS collection system is located within the City limits of Waco**. Due to limited available space (at locations that are compatible with system hydraulics) as well as anticipated difficulty in the operation and maintenance of such facilities within the system, WMARSS and the City of Waco have determined that future equalization facilities within the WMARSS (i.e. City of Waco) collection system should be located at the Central Wastewater Treatment Plant. This was decided due to a number of reasons which include ease of operation, maintenance, control, and environmental factors. Added to the above reasons, **this approach was additionally determined to be the most economical long-term solution for the City of Waco (and WMARSS).** The Team concurs with this decision and approach. Therefore, based upon the City's stance, the Team has moved forward with conveying peak wet weather flows to the Central Plant and not locating flow-equalization facilities within the collection system. The only slight exception to this approach is the future siting of a WWTP (scalping plant) within the Speegleville Basin as discussed in Section 7.3.5.

7.3.7. Prioritization of Future Detailed Evaluations to Identify RDII

Within the 1-20 Year CIP (see Chapter 8), the overall quantified goal of the various projects does not purposefully address the reduction of rainfall-derived infiltration and inflow (RDII) within the City's collection system. RDII reduction may be a side benefit of a number of the identified projects, but it is not the primary goal. RDII is a concern for most municipalities due to the combination of high amounts of precipitation and relatively "tight soils" that direct significant amounts of groundwater and surface runoff into the sanitary sewer system. As the condition of the mainlines, service laterals and manholes continue to deteriorate over time, more RDII is allowed into the system. Significant portions of the Waco collection system are relatively old and significant RDII has been reported and documented. As was discussed in Chapter 2, a number of system wide improvements were made with the goal of reducing RDII during the 1990's. Since that time, it is understood that only limited work has been completed within the last 10 to 15 years. This is corroborated based upon last year's system wide flow monitoring work that revealed that peak wet weather flows resulting from RDII are on the order of magnitude of 8-12 times that of average dry weather flows.

Asset Renewal Project Nos. 2, 3, 4 and 5 (2019, 2023, 2027 and 2031) are the projects that are most likely to positively address the high peaking factors that currently exist within Waco's collection system. Industry wide, empirical evidence illustrates that 30% or more or the volume of wet weather peak wastewater flow is a result of improperly maintained private service laterals. Moreover, defective private service line cleanout covers account for approximately 60% of the system defects in a typical wastewater collection system. Many municipal entities have undertaken cleanout cover replacement programs such that the municipality will replace the cleanout cover at no cost to the property owner in exchange for permission to perform the work on private property.

Utilizing the temporary flow monitoring data (discussed in Chapter 4), Table 7-2 provides a list of the measured peaking factors.

Table 7-2: Temporary Flow Meter Locations

Meter	Basin	Address	Peaking Factor
BB01	Barron's Branch	201 N. University Parks Dr	3.7
BB02	Barron's Branch	1521 Alexander Ave	11.3
BB03	Barron's Branch	2798 Glendale	15.4
BB04	Barron's Branch	504 N 6th Street	10.2
BZ01	Brazos	2300 S University Parks Dr	4.0
BZ02	Brazos	27 Bagby Ave	4.0
BZ03	Brazos	1225 S Jack Kultgen Expwy	10.5
BZ04	Brazos	898 N 30th St	8.1
BZ05	Brazos	400 S 4th St	8.0
BZ06	Brazos	2400 Webster Ave	9.8
CW04	Cottonwood	1413 S Jack Kultgen Expwy	15.2
CW05	Cottonwood	1413 S Jack Kultgen Expwy	7.0
CW06	Cottonwood	Remote	3.2
CW07	Cottonwood	4520 Hiland Dr	7.0
CW08	Cottonwood	900 Valley Mills	5.5
FC02	Flat Creek	880 Panther Way	3.9
MK01	MLK	800 E 7th St	8.8
MK04	MLK	758 S MLK Blvd	8.6
MK05	MLK	305 Mill Street	9.4
PR01	Primrose	Gurley Lane	8.1
PR02	Primrose	2619 Primrose	10.3
TB01	Primrose	7321 Bosque	5.6
TB02	Twin Bridges	1936 La Porte	9.5
VL01	Twin Bridges	4701 Steinbeck Bend Dr	14.2

Several of the temporary flow meters that showed lower peaking factors are located downstream of meters that measured much higher peaking factors. It is assumed that overflows occurred upstream of these areas, therefore lowering the peaking factors at these downstream locations. The peaking factor measured at meter VLO1 was nearly the highest in the system at 14.2. It is believed by the Team and Waco staff that an upstream line likely has a small number of areas that have an extreme inflow problem. As schedules permit, Water Utilities staff has been inspecting portions of the collection system in an effort to reduce the peak weather flows. This effort should continue until this issue can be resolved. Additionally, the City has indicated that the Waco Industrial area (North Flat Creek wastewater line within the Flat Creek Basin) has RDII problems.

It is recommended that portions of the prioritized basins one through nine (shown in Table 7-3) be investigated further within the next 10 to 20 years.

Table 7-3 provides a listing of the major basins prioritized by need for additional investigation (to include Sanitary Sewer Assessments (SSA)) to be performed in the future. This list was developed independently and additionally evaluated with City staff in order to ensure that the results presented are consistent with historical and institutional knowledge. Therefore, the prioritized list is considered a collaborative effort between the City staff and the WWMP Team.

Table 7-3: Prioritization of Basins for Inflow & Infiltration

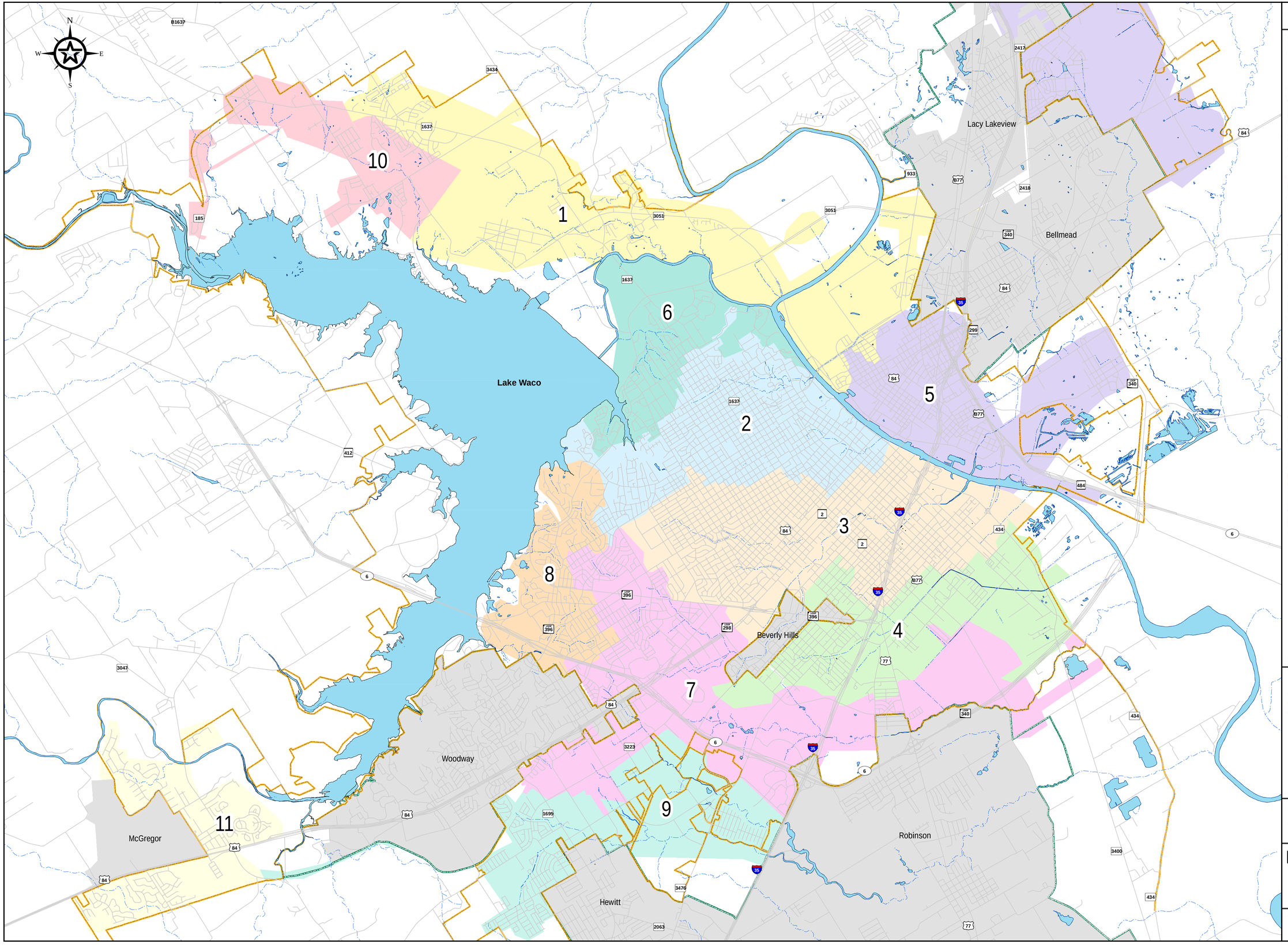
Priority	Basin
1	Carver
2	Barron's Branch
3	Brazos
4	Primrose
5	MLK
6	Bosque River
7	Cottonwood
8	Twin Bridges
9	Flat Creek
10	Village Lake
11	Speegleville

The 20 Yr. CIP does not specifically contain SSA projects (that level of detail is typically not included within the scope of a master planning effort). However, SSA's should be considered by the City to be incorporated within the Asset Renewal Project Nos. 2, 3, 4 and 5 (2019, 2023, 2027, and 2031). The City should methodically move through the list within Table 7-3 as each subsequent series of asset renewal projects are undertaken. At this time, it is recommended that at least portions of prioritized basins one through nine require additional investigation.

SSA's should be undertaken to identify structurally deficient lines within the collection system as well as identify inflow and infiltration locations in order to address the excessive peak wet weather flows within the older portions of the City's collection system. Based upon availability, City staff may potentially be able to perform a portion of the CCTV testing services in order to reduce the cost of these projects so that the work will not be outsourced. **The assessments will help pinpoint areas of the system that require rehabilitation in order to reduce the overall flow into first Waco's collection system and then the WMARSS system.** Rehabilitating and/or replacing structurally deficient service lines will preserve existing system hydraulic capacity for future growth and reduce the City's cost of expending its citizen's taxes to pay for excessive wastewater treatment.

Work associated with Sanitary Sewer Assessments requires a balanced plan of action. Elimination of SSO events that ultimately result in increased downstream demand for interceptor capacity must correspond with appropriate capacity improvements within the interceptor system. A traditional approach to reduce peak wet weather flow is the implementation of a program of continuous sanitary sewer evaluation and maintenance along with a program of system rehabilitation activities. This approach typically produces a program that meets the stated objective of reducing the amount of extraneous water entering the collection system, which results in a reduction of peak wet weather flow. This approach is effective when conducted in a continuous fashion and in combination with active system maintenance activities.

THIS PAGE IS INTENTIONALLY LEFT BLANK



LEGEND

- 2 — **BARRON'S BRANCH (BB)** (BARRON'S BRANCH, CAMERON PARK 2, DEERWOOD, HILLCREST, LANDON BRANCH, LINDSEY HOLLOW, LOVER'S LEAP, SOUTH LANDON BRANCH, WINDMILL HILL)
- 6 — **BOSQUE RIVER (BR)** (BOSQUE RIVER, CHIMNEY HILL, GREENLEAF PENINSULA, PARK LAKE, VILLAGE GREEN)
- 3 — **BRAZOS (BZ)** (BRAZOS, WACO CREEK NORTH, WACO CREEK SOUTH)
- 1 — **CARVER (CR)** (AIRPORT, AVON, BOSQUEVILLE, CARVER, FALCON POINTE, KEY'S CREEK, LANDING, MAMMOTH SITE, PARKVIEW, RIVERBEND BALLPARK, STEINBECK BEND)
- 7 — **COTTONWOOD (CW)** (COTTONWOOD, FM 434, SOUTH 12TH, SYRIAN CLUB, UPPER COTTONWOOD, UPPER WACO CREEK)
- 9 — **FLAT CREEK (FC)** (ARROWHEAD, FLAT CREEK, NORTH FLAT CREEK, PANTHER WAY)
- 5 — **MARTIN LUTHER KING (MLK)** (CHICKEN SHACK, EAST MLK, LINCOLN PARK, MCLENNAN COUNTY JAIL, TSTC, WEST MLK)
- 4 — **PRIMROSE (PR)** (PRIMROSE, SOUTH PRIMROSE, TX STATE LITTLE LEAGUE, VA, WEST PRIMROSE)
- 11 — **SPEEGLEVILLE (SP)** (84 LAWYER, BUCKINGHAM, HARRIS CREEK, LEDGE STONE, RIVER PARK, RIVERSIDE, SPEEGLEVILLE, STONE CREEK, TWIN RIVERS)
- 8 — **TWIN BRIDGES (TB)** (INVERNESS, LAKE SHORE, MT SELMA, RIDGEWOOD, TWIN BRIDGES, WOODED ACRES)
- 10 — **VILLAGE LAKE (VL)** (CHINA SPRING, FLAT ROCK, FM 185, VILLAGE LAKE, YANKIE)

Stream

Surface Water

Waco City Limits

Waco ETJ Limits

CITY OF WACO

0 1625 3250 6500

GRAPHIC SCALE (FEET)

Figure 7-19: Prioritization of Basins for Inflow & Infiltration

G:\GIS\Projects\1-02231\Maps\Basin I&I Prioritization.mxd

THIS PAGE IS INTENTIONALLY LEFT BLANK

CHAPTER 8 – PROPOSED IMPROVEMENTS AND PRIORITIZATION

8.1. Prioritized Capital Improvement Program

Wastewater Priorities:

- ***Identify gravity interceptors that are inadequate during wet weather events***
- ***Replace or rehabilitate structurally deficient gravity sewers***
- ***Identify essential lift station improvements and / or replacements***
- ***Identify flow transfers to improve system operation***

Appropriate short-term and long-term collection system improvements were developed by the Team and then vetted with City staff. The 1-10 Year improvements address historical problem areas, structurally deficient areas of concern, as well as existing hydraulically deficient areas. **Each of these improvements were identified based upon data collected throughout the master planning effort and integrates the information developed as part of the temporary flow monitoring, hydraulic capacity evaluation, and lift station assessments.** Finally, the 1-10 Year improvements also align with the 2014 Water Utilities budget highlights and/or priorities,which include:

- Completion of a series of identified projects located throughout the collection system that will address gravity interceptors that are hydraulically inadequate during wet weather events. These recommended projects are intended to improve the overall service, reduce stop-ups, and reduce infiltration and inflow within the existing collection system.
- Identification of a series of asset renewal projects of structurally deficient lines to either replace or rehabilitate failing assets within the existing collection system.
- Evaluation of essential lift station improvements and/or lift station replacements within the existing collection system.
- Evaluation of flow transfers within the existing collection system (primarily located south and east of the Brazos River and within the more established (older) portions of the City) allowing improved operation of the collection system.

8.2. Cost Estimating Procedures

The methodology used as part of the master planning effort in establishing the various Opinions of Probable Improvement Costs will create a baseline to compare and then assist in prioritizing system improvement recommendations.

8.2.1. General

The total project cost of each recommended capital improvements project is comprised of Construction Costs and Soft Costs.

Cost estimating procedures have been applied that are consistent with this type of master planning effort. **Two major cost categories (Construction Costs and Soft Costs) are employed to determine the total cost for each identified project.** Construction costs include the direct costs, such as materials, labor, and equipment required for the construction of the recommended infrastructure. These are the costs that are included in the construction contract portion of a project. Soft costs include additional expenses not directly associated with construction activities. These can include, but are not limited to, items such as project engineering, survey, land acquisition, contingencies,

and environmental studies. Construction and soft costs comprise the total project cost of each recommended capital improvements project. Operational and maintenance (O&M), energy, and debt service payments are examples of typical annual costs incurred with wastewater facilities. These costs are not included in the cost estimates in this Master Plan. The preliminary costs associated with each of the recommended projects took into account the hydraulic analysis and identification of the required elements, sizing, and location. The estimated Opinion of Probable Improvement Cost for each recommended project was developed from this information. **The capital costs provided with the Master Plan are based on 2014 dollars. Costs should be adjusted for changes in inflation, materials cost, labor, and bidding climate in the future.** Various databases of construction bid tabulations were utilized to present the best available project costs to the City.

8.2.2. Pipelines (Open Cut)

Waco has historically utilized open cut construction methods for the replacement of existing wastewater pipes that are in poor condition.

The City of Waco has historically utilized open cut construction methods for the replacement of existing poor condition wastewater pipes (both small and large diameter) due to the cost-effectiveness of the technology in this region of the country. Within the last 25 years, PVC materials have been utilized as the preferred replacement pipe material for small diameter gravity pipes (24-inch diameter and less). Within the last 10 to 15 years, either PVC or Fiberglass materials have been utilized as the preferred replacement pipe materials for large diameter gravity pipes (>24-inch diameter). **Open cut replacement methods are generally used for situations where the pipe to be installed is up to a 15 ft depth in most urban areas and generally up to a 25 ft maximum depth in rural areas.** Pipeline construction costs are influenced by pipe materials, bedding requirements, geological conditions, urbanization level, terrain, and special crossings. Costs were broken into “Rural” meaning relatively open areas with occasional road crossings and “Urban” meaning installation under a roadway with numerous existing utilities.

Table 8-1: Pipeline Costs (Open Cut)

Pipe Diameter (INCHES)	Rural ($/FT)	Urban ($/LF)
8	$ 65	$100
12	$ 95	$120
15	$ 125	$140
18	$ 150	$165
21	$ 175	$190
24	$ 195	$ 245
27	$ 260	$ 325
30	$ 280	$ 350
36	$ 380	$ 475
42	$ 460	$ 575
48	$ 560	$ 700
54	$ 640	$ 800

Additional capital cost items for pipeline projects include trenching, bedding, pipe, backfill, testing, and clean up. A typical road or railway crossing involves digging pits on both sides of the obstacle. One pit serves as a launching pit and the other as a receiving pit. These crossings require a casing to protect the roadway or railway in the event of an emergency. Costs for these crossings within the Master Plan are based on $15 per inch diameter of casing pipe per foot of bore.

8.2.3. Pipelines (Rehabilitation)

Trenchless rehabilitation techniques are being used more often as they become a more cost effective alternate when compared to open cut construction.

In lieu of replacing pipes in poor condition by open cut means and methods, **existing lines may be rehabilitated using the commonly utilized trenchless technology of either CIPP (cured in place pipe) or pipe bursting.** Both CIPP (normally on larger diameter lines) and pipe bursting (normally on smaller diameter lines) is being utilized more frequently each year as these technologies have become a more cost-effective and reliable alternative. Pipeline rehabilitation construction costs are influenced by pipe materials, existing bedding materials, geological conditions, urbanization level, and depth. Capital costs for pipeline rehabilitation include those items required to complete the work such as testing and clean up.

Table 8-2: Pipeline Costs (Rehabilitation)

Pipe Diameter (INCHES)	($/FT)
8	$ 95
12	$ 130
15	$ 140
18	$ 150
24	$ 170
30	$ 190
36	$ 230
42	$ 300
48	$ 380
54	$ 480

8.2.4. Lift Stations

For master plan level cost estimating, **the following costs are provided for lift stations based on the pumping capacity required to meet peak flow conditions.** Capital costs for lift stations include the cost of pumps, structures, motors, electrical improvements, instrumentation, site work, and other materials. Based on the recommended improvements and flow conditions, an estimated pumping capacity for the station is calculated and used for the compilation of lift station costs.

Table 8-3: Lift Station Costs

Lift Station Type (MGD)	Lift Station Type (GPM)	Cost
New – 0.25 MGD	174 GPM	$375,000
New – 0.50 MGD	347 GPM	$575,000
New – 1.00 MGD	695 GPM	$625,000
New – 1.50 MGD	1,042 GPM	$675,000
New – 2.00 MGD	1,390 GPM	$800,000
New – 3.00 MGD	2,085 GPM	$1,050,000
Expansion – 0.5 MGD	347 GPM	$350,000
Expansion – 1.0 MGD	695 GPM	$385,000
Expansion – 1.5 MGD	1,042 GPM	$450,000
Expansion – 2.0 MGD	1,390 GPM	$600,000
Expansion – 3.0 MGD	2,085 GPM	$750,000

8.2.5. Soft Costs

Soft costs for each project include professional services such as engineering, surveying, legal, and project administration, as well as project contingencies. T**he City of Waco directed that at this stage of project development that soft costs of 37.5% of estimated construction costs be utilized. This is comprised of 12.5% for engineering and surveying and 25% for contingencies.**

8.2.6. Land Acquisition

Projects requiring land acquisition include the cost associated with the purchase of the land or easement as well as the cost for acquiring the property/easement.

Land related costs for a project can typically be divided into two categories which include land/easement purchase and property/easement acquisition services. Lift stations are typically constructed on properties purchased by the Owner. Pipelines are generally constructed on land in possession of the Owner and traverse in easements or public rights-of-way (ROW).

Two types of easements are usually acquired for pipeline construction. These include permanent and temporary construction easements. Permanent easements are those in which the pipeline will reside once constructed with enough room for future maintenance and expansion. Temporary construction easements provide extra working area for equipment and materials necessary for construction activities. Once the pipeline has been installed, the surface is returned to original condition and the temporary easement is released. This effort assumes that permanent easements will be 30 feet in width with temporary easements being 50 feet in width for a total width of 80 feet. A temporary easement, since it reverts back to the original land owner after construction, is typically less expense than a permanent easement. This effort assumes the cost of an easement (temporary construction plus permanent) is estimated at $0.35 per square foot. A number of the proposed pipelines in the 1-10 year Capital Improvement Program will be placed in public ROW which will not require new easements. However, most projects will require new easements as part of the associated project completion.

In addition, a number of sites will need to be acquired for the future lift station facilities. This effort assumes that one acre will be required to be purchased for each site. Since each site is relatively small, the cost has been estimated at $0.60 per square foot.

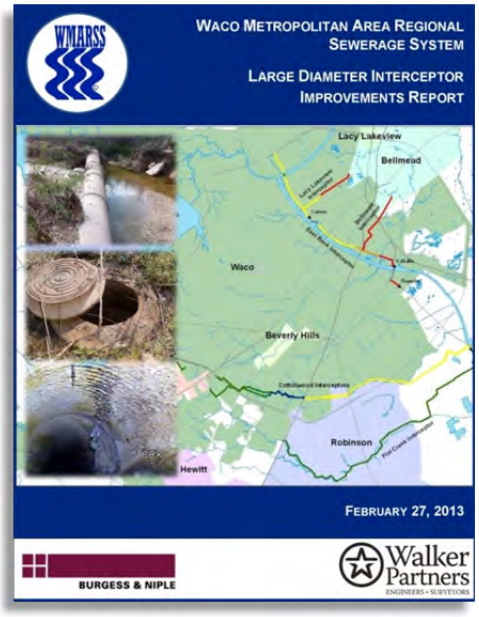
8.3. Project Detail Descriptions 1-10 Yr. Projects (with Opinion of Probable Costs)

This section provides detailed project descriptions of the anticipated scope of work for the prioritized 1-10 Yr. Capital Improvement Projects. Appendix D includes Figure 8-1 which shows the project locations of all of these identified projects. As part of each project, detailed Opinions of Probable Improvement Costs have been developed. These are presented in Appendix D as part of the individual one-page Capital Improvement Program Project Forms. **This format was developed so that all relevant information is located in one place as these projects move to the design and implementation phases.**

8.3.1. Project 1: WMARSS Project No. 1 – LaSalle Lift Station Improvements & Force Main Extension to Central Plant

Project 1 as identified in the February 2013 WMARSS Large Diameter Interceptor Improvements Report, will include the construction of a new WMARSS LaSalle Lift Station and force main to the Central Plant. **The new lift station will relieve capacity issues at the existing LaSalle Lift Station as well as return hydraulic capacity to the existing WMARSS Transfer Lift Station and force main.** In addition, the project will address the very poor structural condition of the existing LaSalle Lift Station. The construction of the new LaSalle Lift Station and force main has the advantage of avoiding the costs associated with providing additional pumping capacity improvements at the existing 30 year old WMARSS Transfer Lift Station. The future LaSalle Lift Station is proposed to be relocated from upstream to downstream of the Lake Brazos Dam (the associated groundwater table elevation below the dam is approximately 15 feet lower than above the dam). Additionally, the existing force main associated with the Transfer Lift Station is currently required to convey flows at a velocity greater than 7 feet per second as prescribed in the TCEQ Chapter 217 rules for lift station design. By rerouting the LaSalle flows away from the Transfer Lift Station, capacity will be freed up at the Transfer site, therefore allowing the existing force main to function more efficiently and within TCEQ design criteria. This in turn will aid in extending the remaining life expectancy of the existing Transfer Lift Station steel cylinder force main. **Finally, this project has been identified in order to reduce the current risk exposure based upon a catastrophic failure of the existing Transfer force main and the associated public perception (reaction) such an event would create.**

The proposed LaSalle force main will terminate at the Central WWTP. A vast majority of the proposed force main route will run parallel to existing overhead power easements or will parallel the existing WMARSS Transfer force main alignment (and existing easements).



Added additional hydraulic capacity within this portion of the WMARSS collection system (the Transfer Lift Station force main) has been discussed as far back as 2003, in a report submitted to the Brazos River Authority (BRA) at the time the BRA was the owner/operator of the current WMARSS system. The 2003 report identified a similar project (parallel 54" Transfer force main and pumping capacity improvements) as a Priority 1 recommendation. **The necessity for an added capacity project within this portion of the WMARSS system has been identified for over a decade.** The wastewater model results indicate that with upstream improvements to the collection system, the 5-year, 6-hour event flows routed to the Transfer Lift station will be in excess of 90 MGD. By off-routing approximately 30 MGD (maximum recorded pumping capacity at the existing WMARSS LaSalle Lift Station) from the existing Transfer Lift Station to the new LaSalle Lift Station, and routing flows directly to the Central WWTP, the Transfer Lift Station will have adequate pumping capacity throughout the planning period (2035). WMARSS is currently moving forward with collection system improvements within this portion of the system. Within the 1-10 Year CIP, the LaSalle Lift

Station Relocation project precedes 13 upstream capital improvement projects.

Figure 8-2: Project 1: 5-year, 6-hour model results – Before Project

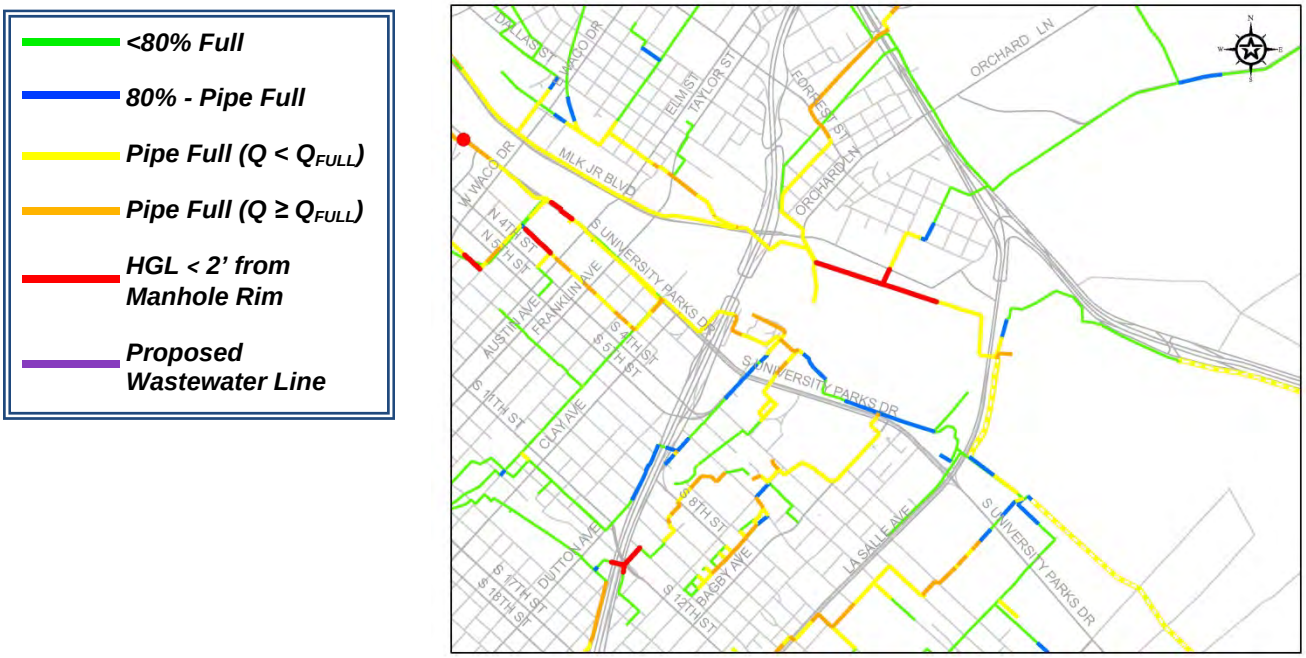
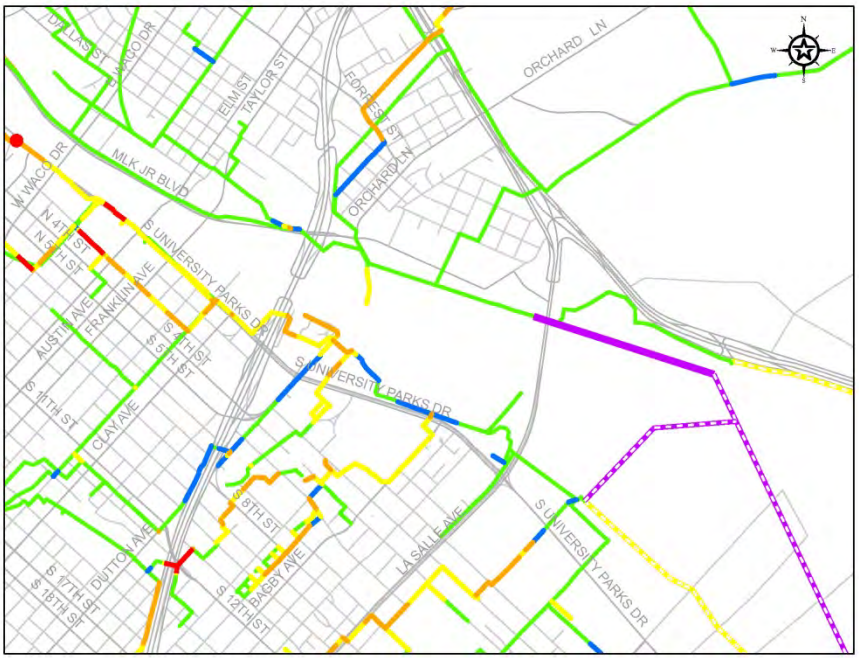


Figure 8-3: Project 1: 5-year, 6-hours model results – After Project

The WMARSS LaSalle Lift Station project is a predecessor project to 13 subsequent identified projects within the 1-10 Yr. CIP.



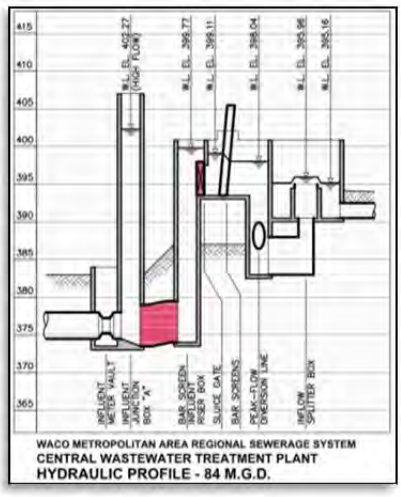
The adverse influences of the Brazos Alluvium should be carefully considered during the proposed design and construction phases in this area. The geology can change significantly in short distances.

Comprehensive geotechnical investigations are necessary to ensure the successful completion of the project.

It is recommended that the proposed Project No. 21 scope (Section 8.3.21) be taken into account during the design of this project. The Project No. 21 project description provides more detailed information regarding a couple of items that will affect the future lift station. These items deal primarily with the gross solids loading from the McLennan County Jail and how the solids are currently handled and how they will be handled in the future.

Project 1 (Figure 8-4) is recommended for implementation in the year 2015. Easement acquisition will be required for the identified improvements. **The WMARSS Large Diameter Interceptor Improvements Report included an estimated project cost of $40,715,000.00 for Project 1. The City of Waco participation amount (currently @ 75.3%) is $30,660,000.00.**

As part of this project, improvements at the Central Plant should also be completed. These improvements include necessary upgrades at the headworks and/ holding ponds. With the rerouting of the LaSalle flows, there will be a corresponding increase in wet weather flows to the Central Plant requiring the construction of improvements to handle the anticipated future flows that will reach the Plant through the improved collection system.



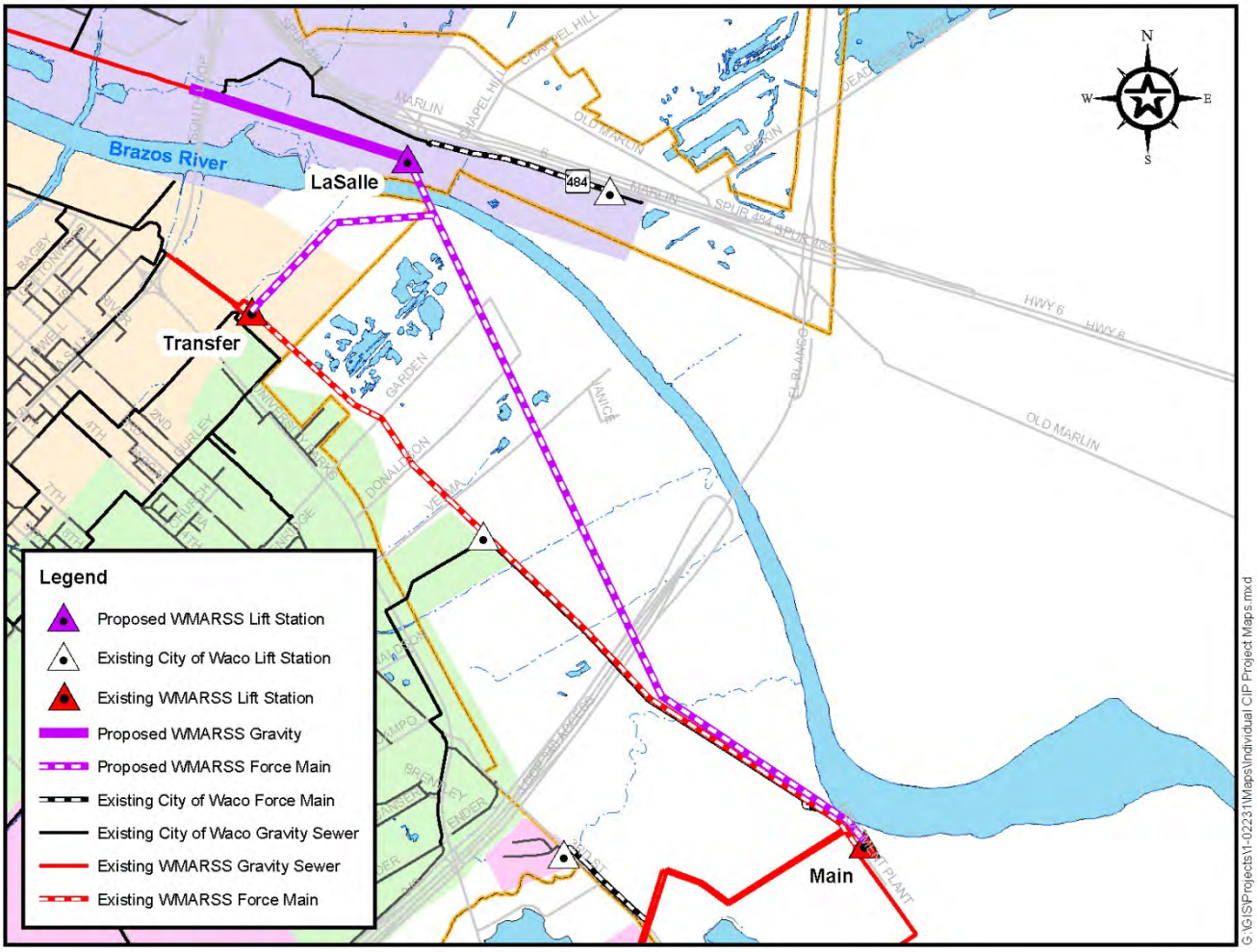
Hydraulic Profile at the Central Wastewater Treatment Plant

Currently, there are several capacity bottlenecks at the Central WWTP that will need to be addressed in conjunction with routing additional flows from a new LaSalle Lift Station. The gravity flow capacity of the 66" pipeline between Junction Box A and the headworks is limited to approximately 120 MGD before water will be in danger of overtopping the structure at Junction Box A (see figure to left). In addition, a hydraulic bottleneck at the inlet to the screen channels limits flows through the headworks. Two of the three perforated plate "bar" screens at the Plant are old and require replacement in order to provide reliable screening capacity for the anticipated increased peak flows. These types of mechanical equipment upgrades will need to be analyzed and carefully considered when determining the final scope of the needed improvements. Due to the current hydraulic constraints, the flows from the Transfer LS and Main LS have to be carefully controlled as to not exceed the hydraulic capacity at the Plant. This leads to procedures of operation that cause flows to back up in the collection system. In order to not exceed the capacity of the structures at the head of the Plant, the lift stations are operated in such a way that the volume of the collection system pipes approaching the lift stations are used as in-line storage. These backed-up flows cause solids to settle out creating potential odor and corrosion problems while also potentially reducing the pipes capacity. By rerouting the flows from the LaSalle LS away from the Transfer LS, much of the peak capacity of the Transfer LS will be made available for flows entering the station through the gravity collection system on the south side of the Brazos

Previous evaluations have recommended increasing the pumping capacity at the Main Lift Station from 43 MGD to 70 MGD. The LaSalle Lift Station Relocation and Force Main to Central Plant Improvements Project will allow the Main Lift Station Improvements to occur.

River. This approach will allow all three lift stations (LaSalle, Transfer and Main) to operate in a more conventional "flow-in-equals-flow-out" fashion. Removing the LaSalle flows from Junction Box A will allow WMARSS the opportunity to increase the pumping capacity of the Main Lift Station. **The Main Lift Station has been observed to suffer from inadequate pumping capacity resulting in frequent and recurring SSO's immediately upstream of the Central WWTP.** The January 2009 Screening and Peak Flow Evaluation Technical Memorandum by HDR, Inc. recommended increasing the pumping capacity at the Main Lift Station from 43 MGD to 70 MGD. This memorandum additionally recommended increasing the capacity of the existing wet weather holding basin at the Central Wastewater Treatment Plant from 34 MGD to 61 MGD. Furthermore, a review of the March 2008 Technical Memorandum prepared by CDM, Inc. recommended increasing the pumping capacity from 43 MGD to 69.7 MGD. To date, neither of these recommendations has been implemented. The result of the above mentioned improvements will increase peak flows at the Central Plant and thus the need for expanded capacity improvements through the preliminary treatment portion of the Plant. In addition, **the peak flow storage volume is currently limited to the existing single basin located at the Plant. Peak flow storage at the WMARSS Central Plant should be evaluated to ensure that the existing peak flow diversion and storage system is adequate to handle the projected peak flows**. Therefore, additional peak wet weather flow holding facilities at the Central Plant are a highly desirable feature. Wet weather flow control at the downstream end of the interceptor system will allow WMARSS operations staff to improve their control of wastewater flow into the Central Wastewater Treatment Plant and to more closely control wastewater flow characteristics during periods of high rainfall dependent inflow and infiltration while other required improvements are constructed. Further, the addition of flow control features will allow WMARSS more flexibility, now and in the future, for upgrades or improvements to the treatment works. By increasing these capacities at the Plant by approximately 80%, the system will be able to hold and release peak wet weather flows from the Cottonwood Interceptors, the East Bank Interceptor and Flat Creek Interceptor. The Team envisions that this work can be done as part of the estimated Project 1 project cost of $40,715,000.00 that was provided within the WMARSS Large Diameter Interceptor Improvements Report.

Figure 8-4: Project 1: WMARSS Project No. 1 – LaSalle Lift Station Relocation & Force Main Extension to Central Plant



THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.2. Project 2: West Bank Interceptor Rehabilitation (IH-35 to Clifton Robinson Tower and University Parks Science Building to Ferrell Center)

WMARSS East Bank Interceptor near Baylor Football Stadium photo showing failure of trench walls due to existing alluvial soils.

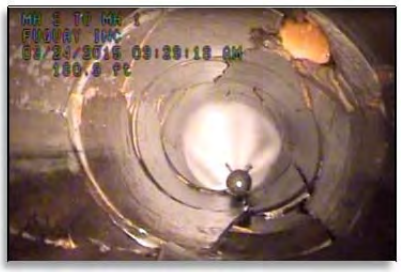
Project 2, as proposed herein, will rehabilitate segments of the 48-inch and 54-inch West Bank Interceptor by cured-in-place or slipline techniques. The existing West Bank Interceptor is located within both the Brazos Alluvium and Lake Brazos water table. The photo to the left indicates just one of the probable constructability obstacles that are seen as part of sewer projects in alluvial soils. The photo indicates that large pockets of "sugar sand" exist in the Brazos Alluvium that creates problems with open cut construction. In addition, the previous East Bank project included dewatering wells that addressed constructability problems associated with groundwater table issues. These type constructability obstacles (along with temporary bypass pumping) make removal and replacement of an existing line along the present alignment difficult. Significant portions of the two existing sections are located either in or adjacent to University Parks Drive or in Baylor's Ferrell Center parking lot.

These segments of the West Bank Interceptor were originally constructed circa 1953 with segmented tile sewer (pipe material). The interceptor is currently approximately 62 years old. **City staff has indicated that the lines in this area are in very poor condition and that both of these segments require immediate attention due to potential imminent failure.** Due to the City's concern about the possible imminent failure of these segments, this project has been identified as the City's number 1 priority rehabilitation wastewater project. It is recommended that the segments be internally inspected using closed circuit television methods as soon as possible to determine the exact nature of the inadequacies.

Previous West Bank Interceptor improvements near Baylor Law School

To further confirm the poor condition of the pipeline, approximately 5 to 7 years ago a portion of the existing West Bank Interceptor was re-aligned as part of Baylor University's facilities expansion near the Law School. **It has been related by personnel associated with that project that the structural condition of the pipe at both the upper and lower project limits of that project is very poor**. The photos show some of the pipe and manholes that were replaced as part of that project.

Rehabilitation of sewer lines using cured-in-place or slipline techniques will typically generate a decrease in the overall conveyance capacity of an existing line due to the decrease in the pipe's diameter. This is one of the primary motives for Project 4 (Brazos Basin Interceptor) being ranked as an extremely high priority project. The proposed Brazos Basin Interceptor will reroute a substantial percentage of the flows that currently flow through the West Bank Interceptor, thereby reducing the impact of the reduction in capacity that will occur as a function of the rehabilitation process. The Brazos Basin Interceptor will also relieve capacity problems on the entire West Bank Interceptor.

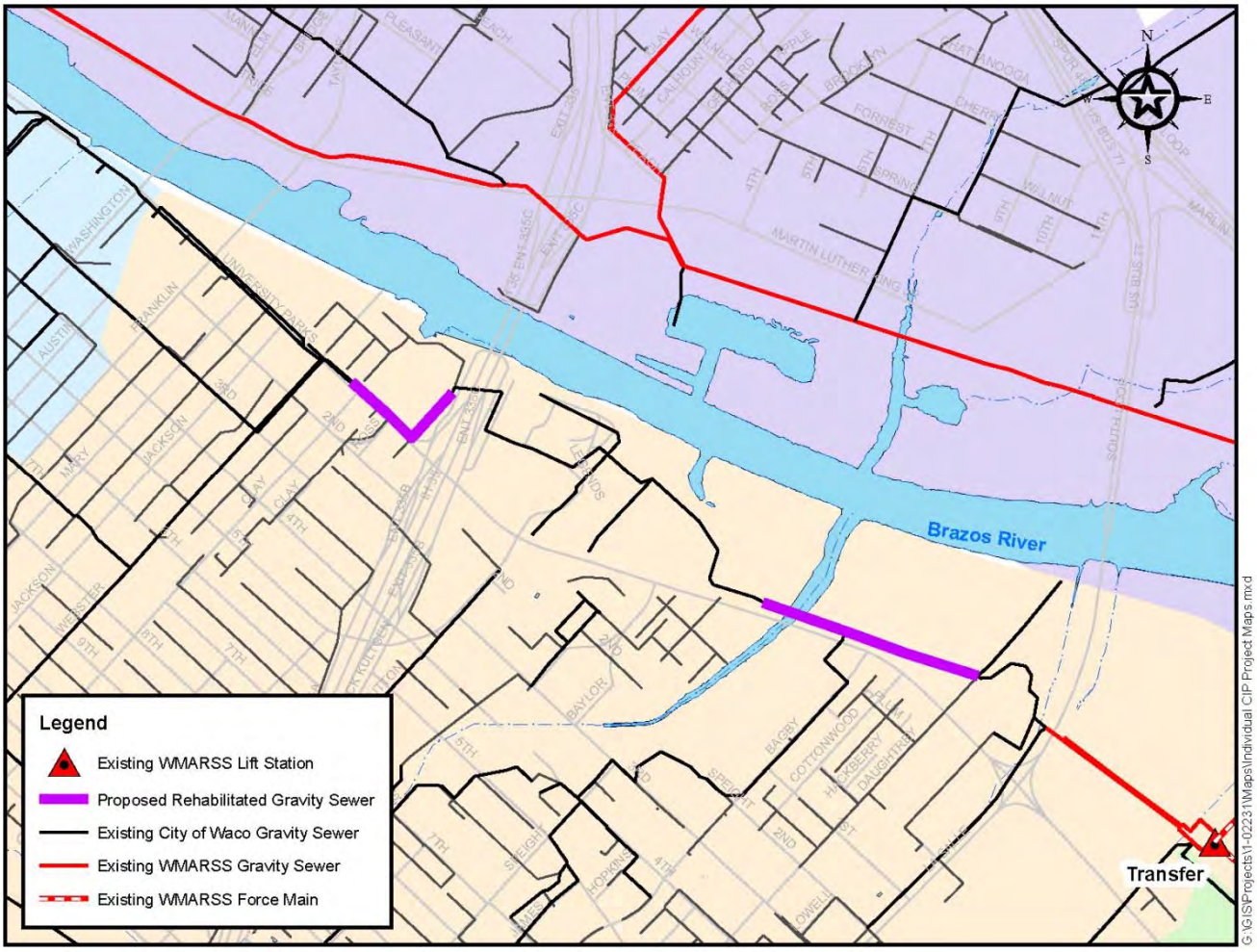


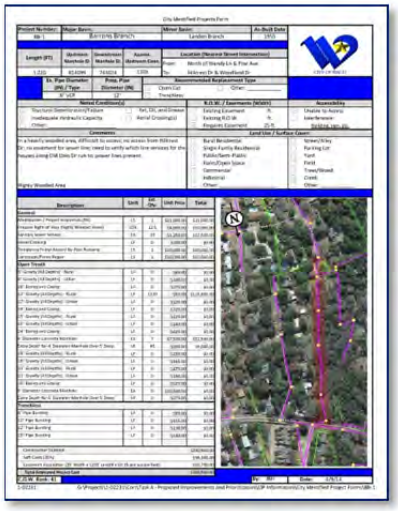
21-inch Gravity Sewer just upstream of West Bank Interceptor.

For various reasons including the Brazos Alluvium, Lake Brazos ground water table, traffic control issues along University Parks Drive, and other adverse commercial impacts to the City of Waco and Baylor University, open cut removal and replacement of the existing interceptor is not considered to be an economical nor practical alternative.

Project 2 (Figure 8-5) is recommended for implementation in the year 2015. Easement acquisition is not anticipated for the identified improvements. The total estimated project cost for Project 2 is $2,280,100.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-5: Project 2: West Bank Interceptor Rehabilitation (IH-35 to Clifton Robinson Tower and University Parks Science Building to Ferrell Center)





One-page summaries associated with each of the 51 Water Utilities identified Asset Renewal Project No. 1 are included within Appendix A.

8.3.3. Project 3: 2015-2018 City Identified Asset Renewal Project No. 1 – Projects 1-51. Replace / Rehabilitate Structurally Deficient Existing Lines

Project 3, as proposed herein, will include the replacement of approximately 135,000 linear feet (roughly 3.8% of the total length of the collection system) of existing 6-inch through 36-inch pipe. The majority of the pipes that have been identified by Water Utilities staff are located predominantly in residential subdivision type areas and are 10-inches or less in diameter. **The replacement of the various segments is expected to assist in reducing current inflow and infiltration (as well as exfiltration) that currently exists at a majority of these locations due to the extremely poor condition of the existing pipelines.** Copies of the 51 independent detailed One-Page Summaries for each of the City identified projects are provided in Appendix A. These summaries were developed in the expectation that they would be an extremely useful tool for both the Water Utilities and Public Works Departments for their ultimate prioritization and implementation. Table 2-9 in Chapter 2 provides preliminary project ranking based upon Water Utilities staff input.

Asset Renewal Project No. 1 includes pipe segments with pipe diameters greater than 12-inches. Subsequent Asset Renewal projects will focus on 6-inch through 10-inch diameter pipes. The larger diameter pipelines in the system will be identified and prioritized through either subsequent Master Plan updates or as part of future Sanitary Sewer Assessments since these are included within the City's sanitary sewer model and command more thorough evaluation.

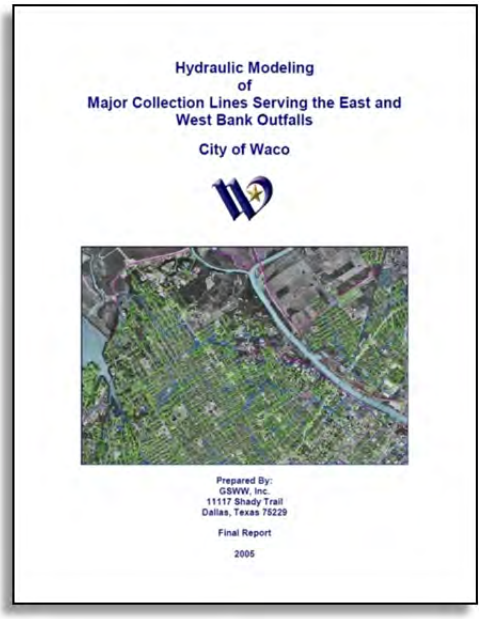
Root Intrusion and Longitudinal Cracking along a clay tile pipe.

Water Utilities staff should begin inspecting these pipes as soon as possible in order to definitively assess the current structural condition and determine the final rehabilitation / replacement strategy and limits. Closed circuit television inspection will assist in ascertaining if the existing lines are in a condition to rehabilitate by trenchless methods (i.e. by pipe bursting). Should the inspection of these pipe segments identify collapses or dropped joints, trenchless rehabilitation methods become much problematic to implement. It is recommended that the City develop an electronic storage system in order to store video footage obtained for the various asset renewal projects, which can be provided to prospective bidders. Finally, the inspection of the lines will also assist tremendously in the ultimate prioritization of the projects. **The One-Page Summaries preliminarily identify the projects as either "open cut" or "trenchless". However, none of the identifications were verified by actual field inspection. By inspecting the various segments, the City will then be able to group similar projects together into larger projects in order to reduce the overall project unit prices due to economies of scale.**

Project 3 is recommended for implementation in the year 2015 and be completed over a four year period (2015 through 2018). The limits of the Project 3 segments are included in the One-Page Project

Summaries within Appendix A. Easement acquisition is anticipated for many of the identified segments. The total estimated project cost for Project 3 is $39,128,500.00. These forms provide preliminary estimated breakdowns for the various project costs.

8.3.4. Project 4: Brazos Basin Interceptor (Lower Limits)



Project 4, as proposed herein, will reroute existing flows away from the West Bank Interceptor and restore available capacity. Multiple areas within the Brazos Basin currently lack adequate hydraulic capacity. **The review of existing studies and reports as part of the master plan effort has led the team to the conclusion that the wastewater system (portions of the Brazos Basin along Waco Creek as well as portions of the Barron's Branch and Primrose Basins) are currently severely overloaded during wet weather events.** This inadequate hydraulic capacity has been confirmed by City of Waco staff and historic work order information. For example, the City's work order system has recorded 22 rainfall driven sanitary sewer overflows from 2009-2013 along the West Bank interceptor and an additional 31 rainfall driven sanitary sewer overflows from 2009-2013 along the existing wastewater lines where the proposed Brazos Basin alignment is expected to be routed. The inadequate hydraulic capacity has also been corroborated by the Team's hydraulic modeling efforts. The proposed project has been identified to eliminate recurring overflows that take place during wet weather events. **By rerouting a substantial portion of the existing flows, crucial hydraulic capacity within the West Bank Interceptor will become available (current inadequate hydraulic capacity) in order to provide for the redevelopment of downtown Waco.**

Significant portions of the proposed Brazos Basin Interceptor were previously identified within the City's 2005 East and West Bank Hydraulic Model Report as having inadequate hydraulic capacity. The Report recommended a number of System Improvement Projects to be completed between 2003 to 2008 in order to address the identified deficiencies.

The existing West Bank Interceptor is located within both the Brazos Alluvium and Lake Brazos water table. These constructability obstacles would make replacement of a larger diameter line along the existing alignment very difficult. The West Bank Interceptor was originally installed in 1953 prior to the construction of the Lake Brazos Dam that raised the water table (and associated ground water table) by approximately 15 feet. **The high water table creates a numerous geotechnical / constructability problems that includes, but is not limited to dewatering, shoring, and trench stabilization.** The anticipated costs associated with constructabilty/water table items associated with the upsizing of the line(s) along the original West Bank alignment are substantial. Dewatering costs alone on the recent WMARSS Baylor Football Stadium Wastewater reroute were well over $550,000.00.

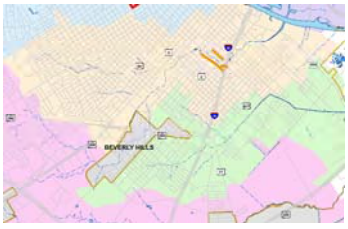
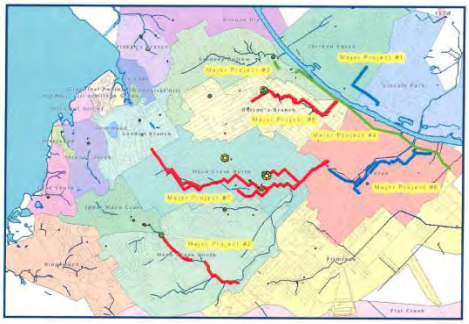


Figure 2-20: Brazos Basin Asset Renewal Area (Orange): Identified by Water Utilities staff

Rerouting flows (by new alignment) away from the Brazos Alluvium / Lake Brazos water table (West Bank Interceptor) are two critical items that warrant consideration since areas closer to the Brazos River require a careful evaluation in terms of the water table and soils. Within the Brazos Basin Interceptor lower limits area, moderate to easy excavation would be anticipated. As the alignment moves farther away from the Brazos River, rock would be anticipated to be encountered that can be difficult to rip requiring heavy machinery. Portions of the proposed Brazos interceptor alignment will require deep gravity sewers (cuts from 15' to 25' depths) to be installed. The costs associated with this proposed project will be high, but hydraulic capacity improvements in this



general area have never been made since the time that the original system was constructed. As this project moves into design, it is recommended that the gravity profile be closely evaluated to determine if adjustments can be designed to allow for the removal and/or abandonment of nearby existing aerial crossings / siphons. **Water Utilities staff has indicated that they have not been able to locate a number of existing manholes (and pipelines) in areas within the Brazos Basin in the general downtown area.**

The "Lower Limits" Brazos Basin Interceptor will provide the following benefits:

2005 East and West Bank Hydraulic Model Report recommended system improvement projects to address the identified deficiencies.

- Currently a 36" wastewater line along Webster ties into the West Bank interceptor. Flow will be rerouted away from West Bank therefore increasing available hydraulic capacity to the West Bank Interceptor. The Project No. 2 description discusses that rehabilitating portions of the existing West Bank Interceptor will reduce the capacity of the line. The 2005 East and West Bank Hydraulic Model Report recommended replacing and increasing the pipe diameter of the West Bank Interceptor.

- Currently an 18"-24" wastewater line is routed through the Baylor Campus and ties into the West Bank Interceptor near Bagby Avenue. City staff has conveyed that historically, this line has experienced hydraulic capacity distress during wet weather events, along with, having structural challenges. The proposed interceptor will reroute flow away from these wastewater lines, thus allowing the lines through the Baylor campus to be rehabilitated by trenchless methods in lieu of having to open cut replace with larger diameter pipelines. Many of the existing pipelines are relatively deep and located close to existing buildings.

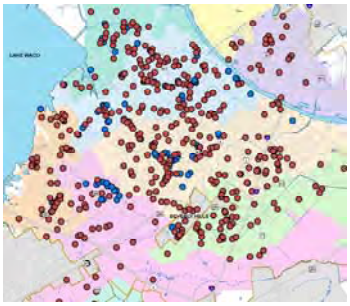


Figure 2-2: SSO-RFE Map (Page 2-18)

- City Utilities staff has conveyed that numerous rainfall driven sanitary sewer overflow locations exist within the limits of this project. This can be attributed to due to both inadequate existing hydraulic capacity and poor structural condition. The identified project will help to address many of these occurrences.

The proposed Brazos Basin Interceptor will reroute current wastewater flows from the currently capacity limited West Bank Interceptor. The existing West Bank Interceptor was constructed in 1953. The City's residential population has grown by 150% since the time it was originally installed.

The "Lower Limits" Interceptor has been preliminarily sized to accommodate the addition of future rerouted flows: Wooded Acres Lift Station, Greenleaf Lift Station, Village Green Lift Station, Park Lake Lift Station, and Chimney Hill Lift Station. See Projects 13 & 25 for the detailed project scope for these projects. During preliminary design, it is recommended that Areas 4 and 5 (Refer to Chapter 2, Figure 2-20) be evaluated for incorporation within the project. City Water Utilities staff has indicated that these areas are problematic. Both segments **are known to be in poor structural condition and exhibit inadequate hydraulic capacity during wet weather events.** These areas were not included in the Asset Renewal (Project 3) since they are located within the general alignment of the proposed Brazos Basin alignment.

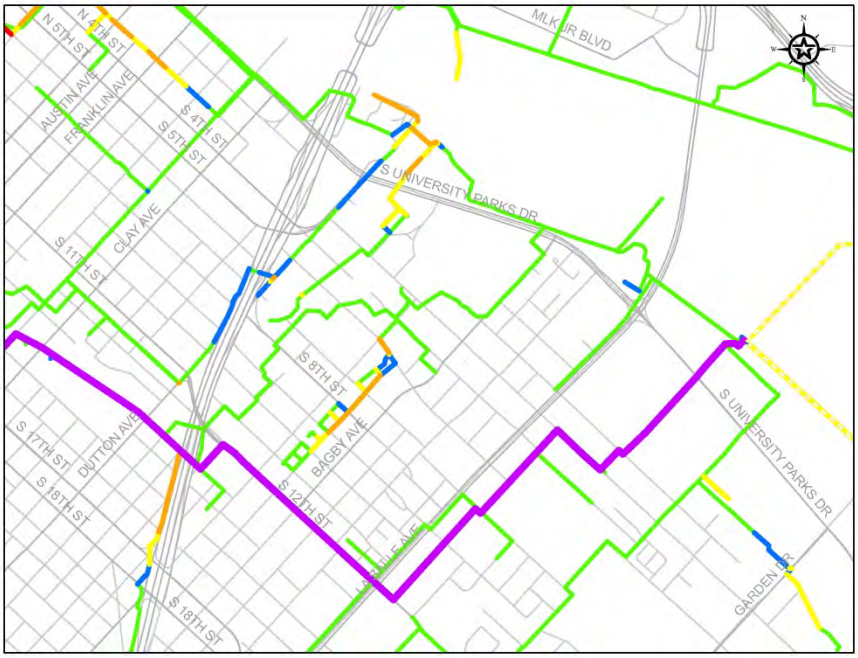
During the Team's coordination with Water Utilities personnel, staff brought forward the need to reroute the Wooded Acres lift station flows back towards the Brazos Basin Interceptor due to high concerns regarding the condition of the existing Wooded Acres force main.

This project is required to be completed prior to Project 7 which will allow for the Landon Branch reroute that has been identified as Provision 12 within the City's Sanitary Sewer Overflow Initiative Plan with the TCEQ. Prior studies assumed that the existing flows could be rerouted from the West Bank Interceptor to the Cottonwood Interceptor. However, further analysis (hydraulic model) has determined that the downstream collection system (Woodway Lift Station and Cottonwood Interceptor) does not have available additional capacity to accommodate the flows that would be rerouted from upstream of the existing Landon Branch station. This analysis is a major reason why Projects 4 and 7 have been identified as high priority projects. **The Landon Branch flows will ultimately be conveyed to a new Brazos Basin Interceptor that will have available capacity that the West Bank and Cottonwood Interceptors do not have. While Project 4 will not include the rerouting of the Landon Branch Lift Station flows, the Brazos Basin Interceptor will be sized to accommodate these future flows.** The City Water Utilities staff identified the need to closely evaluate the potential rerouting of flows at Wooded Acres lift station back towards the Brazos Basin Interceptor due to high concerns regarding the condition of the existing Wooded Acres force main (see Project 13 for additional detail).

Figure 8-6: Project 4: 5-year, 6-hour model results – Before Project

- *<80% Full*
- *80% - Pipe Full*
- *Pipe Full ($Q < Q_{FULL}$)*
- *Pipe Full ($Q \geq Q_{FULL}$)*
- *HGL < 2' from Manhole Rim*
- *Proposed Wastewater Line*

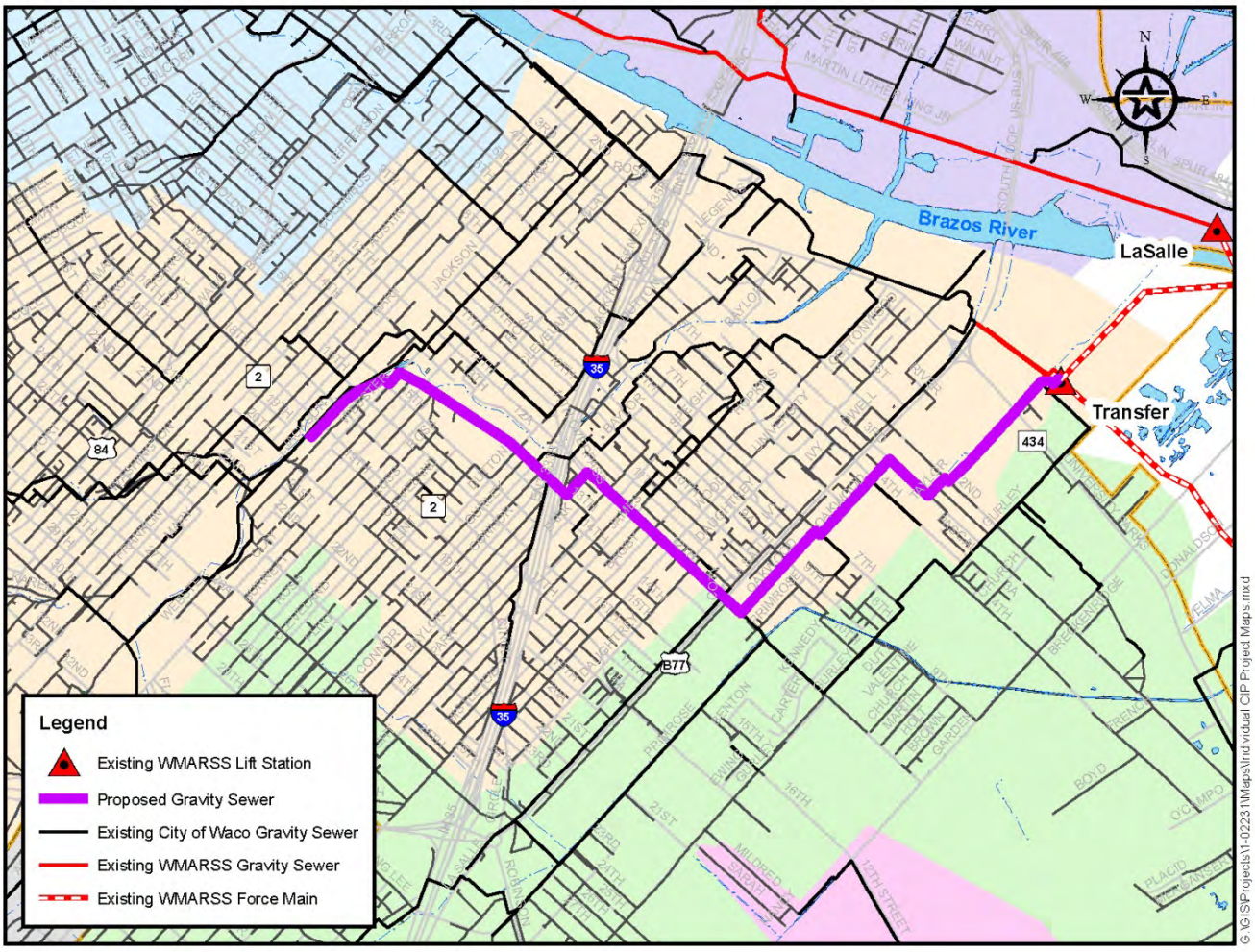
Figure 8-7: Project 4: 5-year, 6-hour model results – After Project



This project should be constructed only after Project 1 (LaSalle Lift Station Relocation) is completed. It is not advisable to route additional peak wet weather flows to the Transfer Lift Station until after the associated 30 MGD LaSalle Lift Station flows have been rerouted from the station.

Project 4 (Figure 8-8) is recommended for implementation in 2016. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 4 is $21,037,800.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-8: Project 4: Brazos Basin Interceptor (Lower Limits)



THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.5. Project 5: Village Lake Hydraulic Capacity Improvements

Project 5, as proposed herein, will be constructed to alleviate the insufficient pumping capacity of the current lift station, thereby reducing the City's risk exposure. **It is recommended that this project be constructed in the near future in order to eliminate the recurring rainfall driven SSO's that regularly occur upstream of the existing lift station.** In addition, the project will also provide future capacity for Village Lake Basin which has been one of two high growth areas in the City.

The Village Lake Hydraulic Capacity Improvement Project will alleviate insufficient pumping capacity of the existing lift station, as well as a segment of the downstream gravity line in order to reduce the City's risk exposure.

The City Engineering Department authored a Technical Memorandum in June 2011 that articulated concerns regarding existing capacity. The memo made reference to growth at a rate of about 8% per year over the last several years within the Village Lake Basin. Additionally, **City Engineering staff calculated that the Village Lake Lift Station has had inadequate pumping capacity since and before 2007 and that the wet well capacity is insufficient based on population.**

Water Utilities staff have major concerns about the significant deficiency in pumping capacity at the existing lift station. **The station is habitually inundated by excessive flows during wet weather events that create overflows upstream of the lift station site on a regular basis.** The existing Village Lake Lift Station was constructed in 1974. Water Utilities staff considers the station's mechanical and electrical condition to be very poor.

Village Lake Lift Station

The current daily peak dry weather flow is estimated to be 200 gpm. This provides a small safety factor for peak flows as the existing pumping capacity is reported to be 600 gpm. **Much of the upstream Village Lake Basin collection system was constructed with PVC pipe within the last 10 to 15 years. It would be practical to assume that this system would allow less infiltration to enter the system than the old clay pipe sections of the city. However, City staff has reported that high peaking factors have been observed and that this condition might be attributable to one or more storm sewer cross connections. It is recommended that this concern be evaluated to determine if one or more cross connections exist which may be the cause of the unauthorized discharges upstream of the lift station and capacity issues.**

Two initial alternatives were evaluated as part of the master planning effort. It is recommended that these, as well as other potential alternatives be further evaluated as the project moves into design. The two alternatives include:

1. Lift Station Option: As discussed previously, the existing Village Lake Lift Station is considered to be severely under capacity based upon historical / institutional knowledge of recurring SSO's upstream of the existing station. The station's outgoing force main is a 9,375 linear foot 12-inch diameter PVC (SDR 26) pipe that has a theoretical

The existing Village Lake Lift Station is severely under capacity during wet weather events based upon historical / institutional knowledge of recurring SSO's upstream of the existing station.

capacity of 2,100 gpm when the pipe is flowing full at 6 ft/sec. **Water Utilities staff has conveyed that historically the City has not been required to perform work order related repairs on the existing force main line.** It is recommended that additional inspections be performed on this circa 40 year old force main to better understand its current structural condition and also determine its estimated remaining useful life. If such inspections demonstrate that the City is able to continue utilizing the force main for at least 10 years or more, it is recommended to move forward with the Lift Station Option. However, if such inspections prove that the force main is considered to be in poor or very poor structural condition (a short estimated remaining life expectancy), the City should strongly consider the Gravity Option.

Approximately 4% of the current total connections in the collection system are located upstream of the Village Lake Lift Station. A flow meter was not located upstream of the station during the temporary flow monitoring due to the number of reported upstream sanitary sewer overflows. The City should perform additional analysis to establish the final proposed firm pumping capacity of the planned station. For project costing purposes, a capacity of 1,440 gpm (1 MGD) was utilized which is a little over two times the current pumping capacity of the existing station.

Preliminary cost estimates show that the Lift Station Option has a lower initial project cost compared to the Gravity Option.

This proposed project would include the replacement of the existing lift station with a new submersible triplex lift station located adjacent to the existing station. **The new station should be designed to include an increased firm pumping capacity that will handle the peak wet weather flows routed to this location.** In addition to the station replacement, it is recommended that a portion of the 10-inch gravity line located downstream of the force main discharge be replaced. Preliminary cost estimates confirm that the Lift Station Option has a lower initial project cost compared to the Gravity Option (described below) since the replacement lift station will continue to utilize the existing 12-inch force main. However, at the time that the upstream flows exceed the capacity of the force main, the Village Lake drainage area will require additional improvements. The Lift Station Option requires continued annual maintenance costs to include power costs, pump replacement costs, etc.

Figure 2-20: Village Lake Basin Asset Renewal Area (Green): Identified by Water Utilities staff (Page 2-51)

Water Utilities staff has determined that the existing 10-inch gravity sewer located downstream of the Village Lake Lift Station force main discharge is problematic from both a hydraulic capacity and structural condition standpoint. Figure 2-20 (Page 2-51) illustrates the identified limits within Area #3. The Area #3 segment is located just downstream of the Village Lake Lift Station force main outfall and is a known hydraulic bottleneck (inadequate hydraulic capacity) during wet weather events. Currently, the system is configured with an existing 12-inch force main discharging into a manhole that has an existing 10-inch gravity line. The undersized 10-inch section should be replaced and upsized as part of the ultimate project scope of the selected option.

Should the Lift Station Option be selected based on further investigations, the City may also want to consider accelerating the timing of the Flat Rock Lift Station Abandonment Project that is included in the 11-20 Year Capital Improvement Program. The abandonment and removal of the Flat Rock Lift Station may allow for the dampening of the peak flows that are conveyed to the Village Lake Lift Station during wet weather events.

The primary reason the Lift Station Option is recommended as the preferred alternative at this time is due to the overall initial project cost since so many other high priority projects have been identified that the City must address within the next ten year period.

2. Gravity Option: At such time that comprehensive inspections warrant the abandonment of the existing force main (due to structural condition or hydraulic capacity), the City should strongly consider that a gravity replacement line be implemented that will concurrently allow for the abandonment of the Village Lake Lift Station. **From a long-term standpoint, a gravity option provides the best long-term solution for this part of the wastewater collection system.**

Preliminary cost estimates show that the Gravity Option has a higher initial project cost as compared to the Lift Station Option.

The Gravity Option (initially sized with a 21-inch diameter line) would require a significant portion of the proposed wastewater line to be installed using deep open cuts (up to 25 feet to 30 feet) along Skeet Easton Road. This option would also likely require trenchless technology for a portion of the length (i.e. in areas where the line would be greater than 30 feet deep) and be aligned under and across a portion of the Waco Airport. This would be recommended since a segment of Skeet Easton Road is located parallel and/or adjacent to portions of the Lake Waco dam. Therefore, constructability considerations should be fully analyzed. A final alignment evaluation is beyond the scope of this assignment. It is envisioned that final alignment evaluation would be vetted as part of a preliminary engineering study. **The cost for the Gravity Option as compared to the Lift Station Option is initially considerably more expensive, however; this option would allow for the abandonment of an existing lift station and therefore eliminate any future operation, electrical, and maintenance costs associated with such a facility.** The Gravity Option would also assist in resolving odor problems that exist around the lift station site. Ultimately**, the Gravity Option will provide the best long-term (permanent) solution for the Village Lake Basin** while satisfying the City's priority of abandoning existing lift stations within the current collection system.

Figure 8-9: Project 5: 5-year, 6-hour model results – Before Project

Figure 8-10: Project 5: 5-year, 6-hour model results – After Project

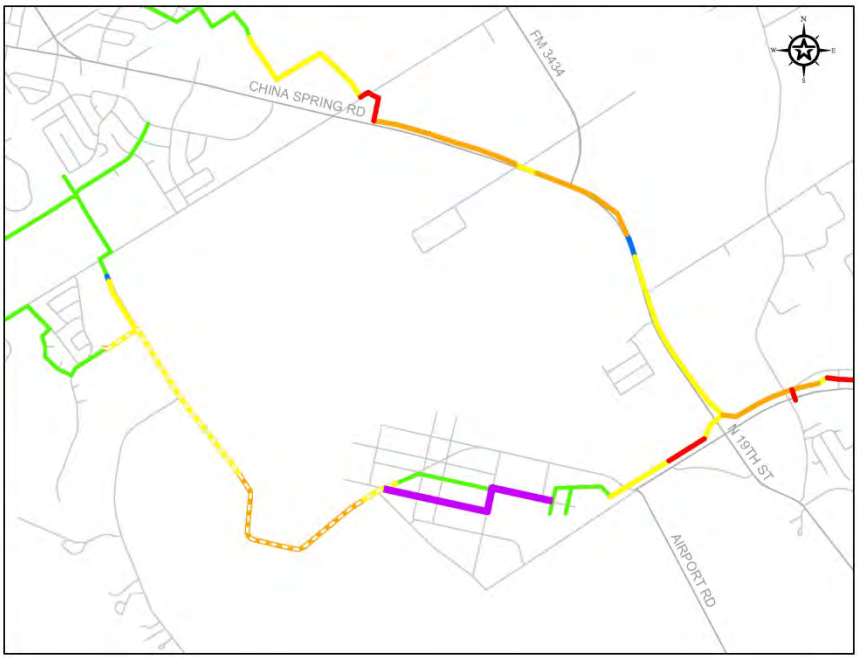
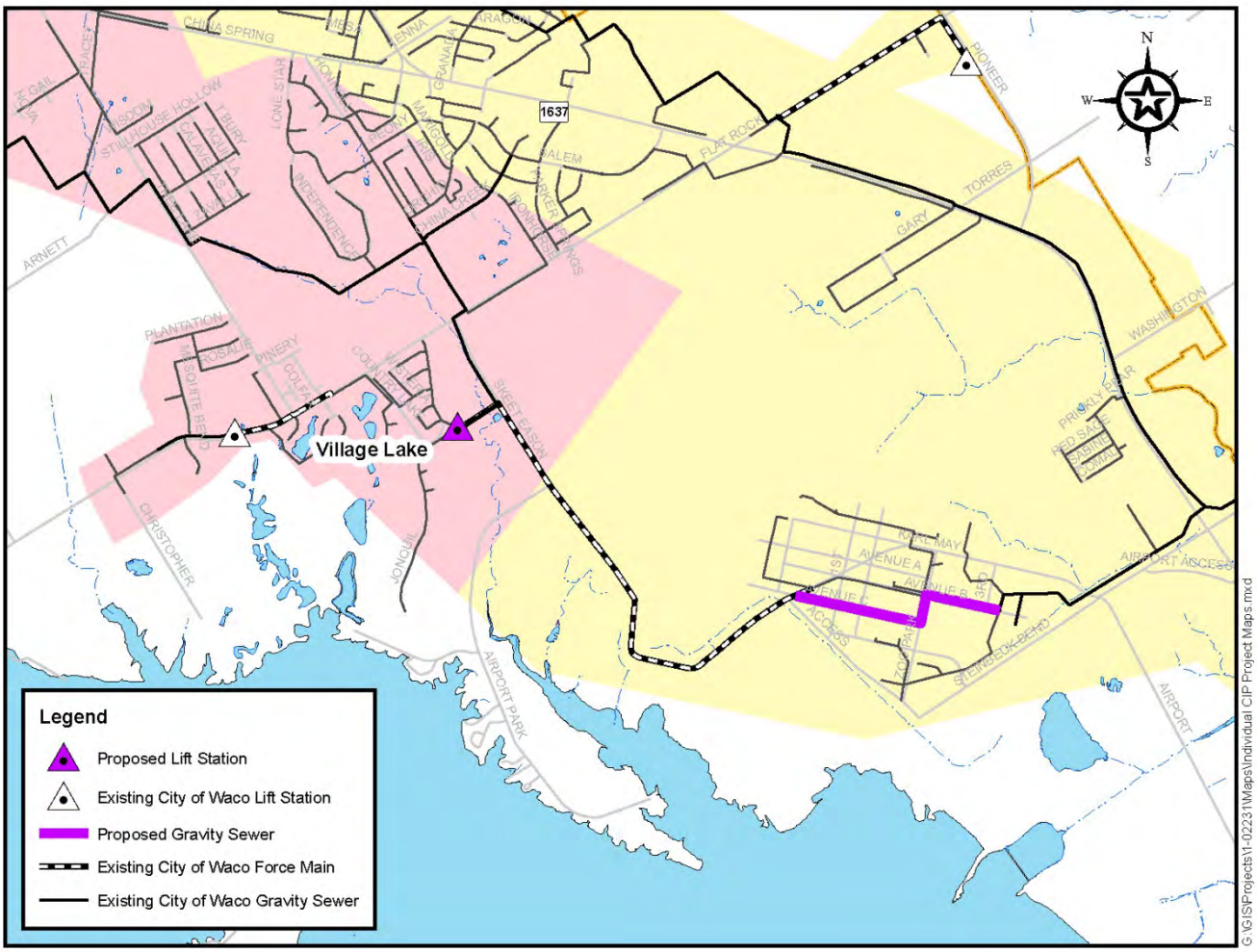


Figure 8-10 shows the results of the Lift Station Option which replaces the existing lift station with a new, increased capacity lift station as well as upsizes gravity lines downstream of the force main outfall.

Project 5 (Figure 8-11) is recommended for implementation in 2016. Easement acquisition is not anticipated for the identified improvements (lift station upgrade and utilize existing force main). The total estimated project cost for Project 5 is $1,766,900.00. Appendix D presents the associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project

cost.

Figure 8-11: Project 5: Village Lake Hydraulic Capacity Improvements



THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.6. Project 6: Reroute Church Road Lift Station Flows from South Flat Creek WWL to Bull Hide / Castleman Creek WWL

Project 6, as proposed herein, will relieve the current inadequate hydraulic capacity that exists in the South Flat Creek Wastewater Line during wet weather events. **Water Utilities staff conveyed during the historical and institutional knowledge phase that the South Flat Creek Wastewater Line experiences rainfall driven sanitary sewer overflows on a regular recurring basis.** This project has been recommended to be constructed in the near future in order to eliminate the identified existing rainfall driven sanitary sewer overflows.

Project 6 will reroute the Church Road lift station flows from the WMARSS Central Plant to the WMARSS Bull Hide Creek Plant relieving the current inadequate hydraulic capacity that exists within the City of Waco South Flat Creek Wastewater Line during wet weather events.

Currently, the Church Road Lift Station force main discharges to the City of Waco South Flat Creek Wastewater Line, then to the WMARSS Flat Creek Interceptor. At the conclusion of this project, the Church Road force main will no longer be routed to the WMARSS Central Plant via the Flat Creek Interceptor, but will be rerouted to the WMARSS Bull Hide Creek Plant. Further definition of the scope of this project is provided as part of a Technical Memorandum to the City dated July 19, 2013 by Walker Partners**. In 2013, the City made the decision that the Castleman Creek and Bull Hide Creek wastewater line be designed to accommodate a future flow of 3.0 MGD from the Church Road Lift Station thus allowing the City to remove the current flows from the City of Waco South Flat Creek wastewater line.**

The Church Road reroute project provides three significant benefits. First, it will reroute flows away from the WMARSS Main Lift Station. The Main Lift Station's firm pumping capacity is currently exceeded during wet weather events. Second, the reroute will convey approximately 1,100 gpm of peak flow (the current firm pumping capacity of the Church Road lift station) to the new 21-inch Bull Hide / Castleman Creek wastewater interceptor. This in turn will remove approximately 1,100 gpm of peak flow from the South Flat Creek wastewater line, freeing up much needed capacity within the South Flat Creek wastewater line. By rerouting these flows, it is anticipated that a majority of the sanitary sewer overflows that occur during rainfall events will be eliminated. Finally, **WMARSS Water Utilities staff has conveyed that they continue to experience operational problems at the Bull Hide Creek WWTP, which are significantly related to the low daily average wastewater flows at the Bull Hide Creek Wastewater Treatment Plant. By completing this project and rerouting the Speegleville Basin flows to the Bull Hide Creek Wastewater Treatment Plant, additional average daily flow of approximately 300 gpm will be conveyed to the Plant, which is expected to help resolve those challenges**.

The proposed project will include an additional length of 12-inch force main as well as a 21-inch gravity wastewater interceptor.

Figure 8-12: Project 6: 5-year, 6-hour model results – Before Project

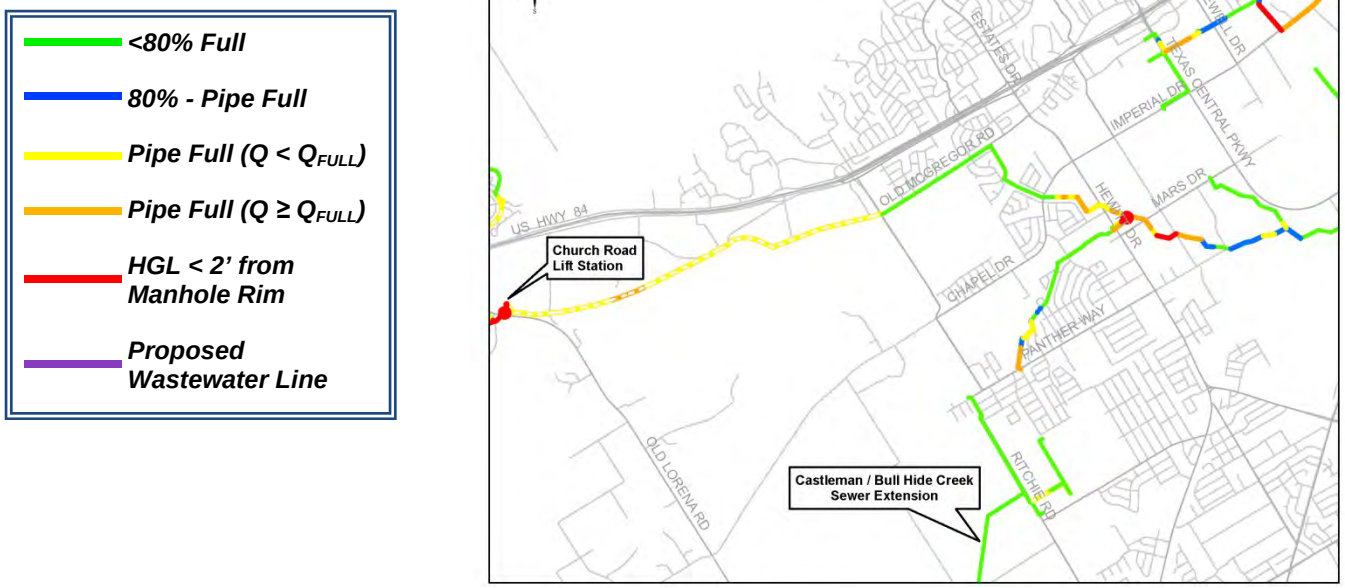
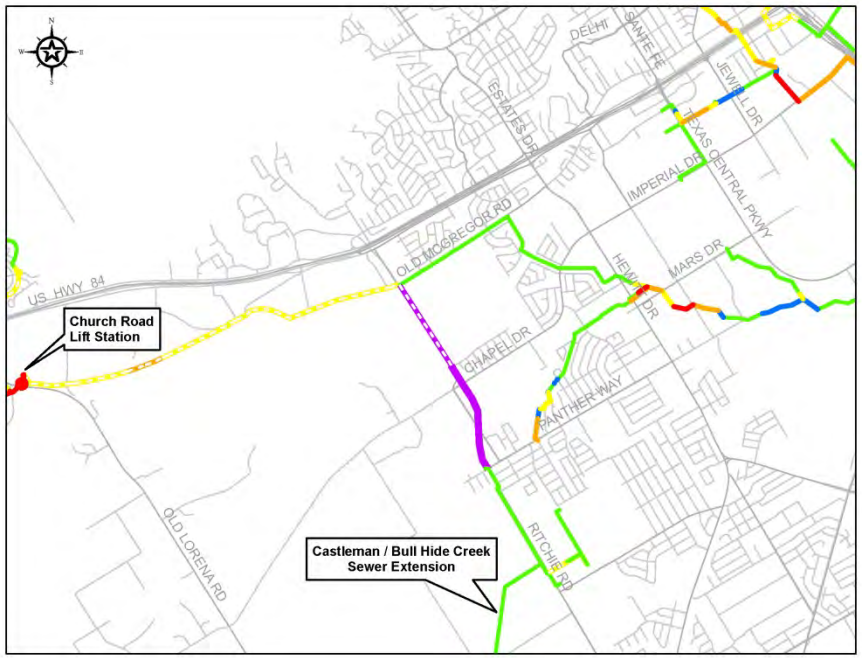


Figure 8-13: Project 6: 5-year, 6-hour model results – After Project



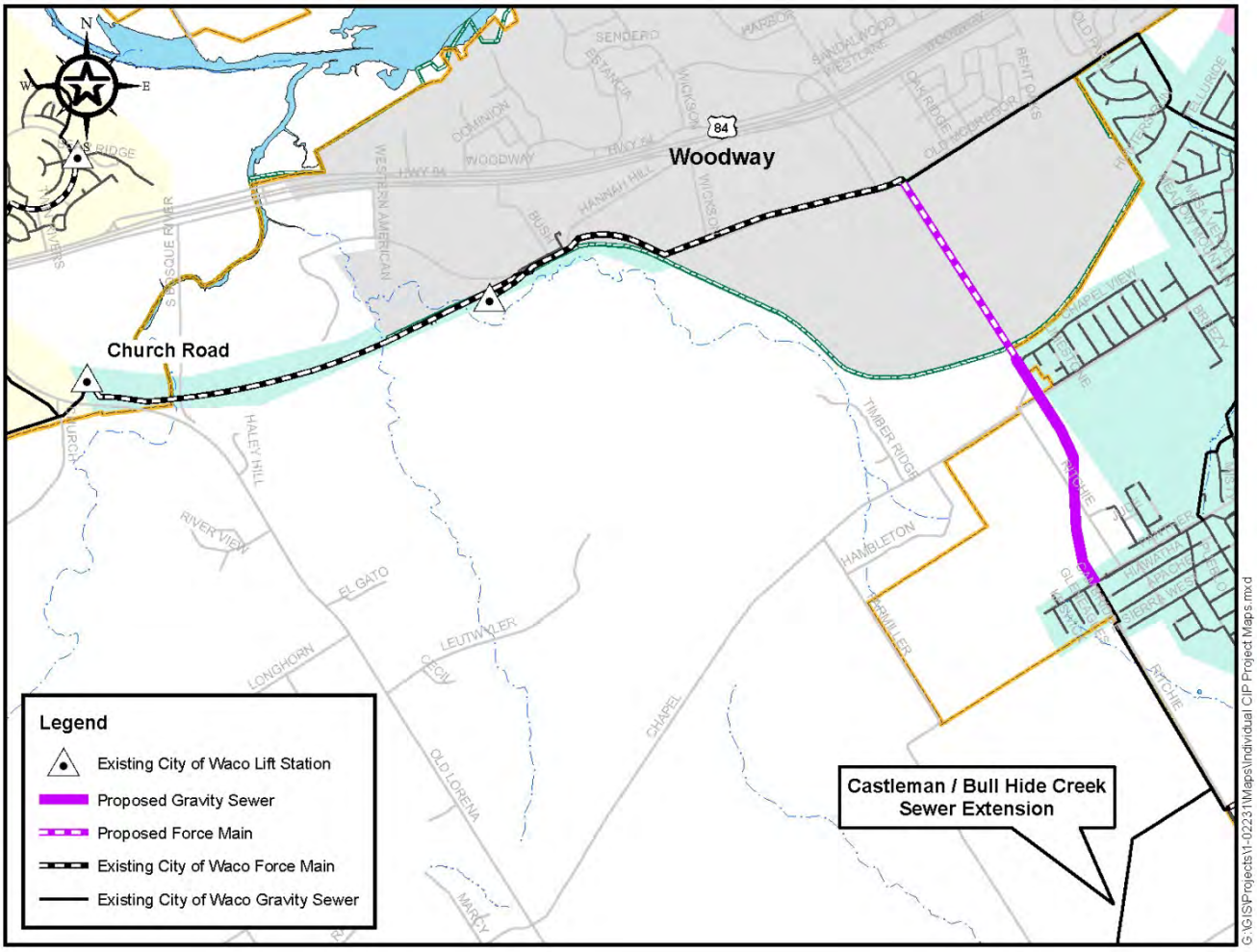
With the completion of this project, the City will have implemented a long-term solution to provide more effective conveyance capacity within the existing Flat Creek Wastewater Basin. In addition, future Project 9 will include increasing the firm pumping capacity of the current Church Road lift station. Current average daily flow is

Currently, SSO's are reported upstream of the Church Road Lift Station. However, the associated flows must be rerouted away from the City of Waco South Flat Creek Wastewater Line before this project can be accomplished.

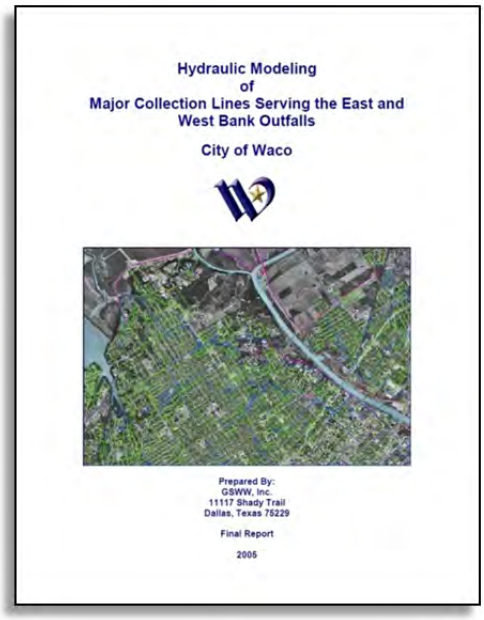
approximately 310 gpm and the current firm pumping capacity is 1,100 gpm. Water Utilities staff has conveyed that SSO's occur upstream of the station during wet weather events. However, **additional pumping capacity at the Church Road Lift Station should not be provided until after the flows are rerouted to collection system lines that have adequate hydraulic capacity.**

Project 6 (Figure 8-14) is recommended for implementation in 2017. Easement acquisition may be required for the identified improvements based upon the amount of right-of-way that Waco acquired as part of the Ritchie Road Reconstruction Project. Easement costs have been included within the project cost. The total estimated project cost for Project 6 is $2,355,425.00. Appendix D presents the associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-14: Project 6: Reroute Church Road Lift Station Flows from South Flat Creek WWL to Bull Hide / Castleman Creek WWL

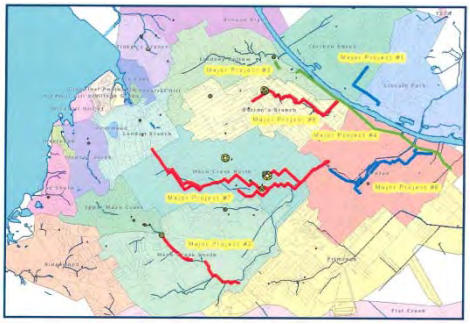


8.3.7. Project 7: Brazos Basin Interceptor (Upper Limits) and Reroute of Landon Branch LS flows From West Bank Interceptor



Project 7, as proposed herein, will allow the West Bank Interceptor to recover needed hydraulic capacity (especially for downtown redevelopment) as well as providing needed additional hydraulic capacity within the Brazos and Barron's Branch Basins. **At the conclusion of this project, the Landon Branch Lift Station flows will no longer be routed to and through the West Bank Interceptor,** which will allow approximately 2,300 gpm of peak flow to be transferred from the West Bank Interceptor to the proposed Brazos Basin Interceptor. It is recommended that this project be constructed in the near future to eliminate existing rainfall driven sanitary sewer overflows that are occurring in the collection system along the West Bank Interceptor near Cameron Park and the Brazos River.

Based upon the review of existing studies and reports, virtually every one of these previous efforts concluded that the City's wastewater collection system that serve the Barron's Branch and Brazos Major Basins are severely overloaded during wet weather events. These major basins comprise significant portions of the system including Lindsey Hollow, Waco Creek, West Bank, and Landon Branch. This inadequate hydraulic capacity was verified in the master planning effort by both Water Utilities staff and the hydraulic modeling tasks. Substantial portions of the proposed interceptor route were also identified within the ***2005 East and West Bank Hydraulic Model Report*** as a ***2003 to 2008 System Improvement Project***.



The 2005 East and West Bank Hydraulic Model Report recommended system improvement projects to address the identified deficiencies.

The reroute of the Landon Branch Lift Station flows has been identified within the City's Sanitary Sewer Overflow Initiative Plan with the TCEQ (Provision 12). The original concept in the SSO Initiative Plan presumed that the Landon Branch flows could be rerouted from the West Bank Interceptor to the Cottonwood Interceptor. However, further analysis as part of the master planning effort has confirmed that the Cottonwood Interceptor lacks adequate peak wet weather capacity to accommodate the additional Landon Branch flows. These items added significant substance as to why the Brazos Basin Interceptor was highly prioritized.

This project should be constructed only after the Brazos Basin Interceptor (Lower Limits) Project 4 is completed. The reasons for this project's recommendation correspond with those of the Brazos Basin Interceptor (Lower Limits) with regard to both geotechnical and constructability issues along the Brazos Basin alignment verses the existing West Bank Interceptor alignment. The existing West Bank Interceptor is located within areas that represent constructability obstacles that make replacement or enlargement of the existing line along the existing alignment difficult. Rerouting flows will free up needed capacity in the West Bank Interceptor as well as reallocate that capacity for the redevelopment of downtown Waco.

Figure 8-15: Project 7: 5-year, 6-hour model results – Before Project

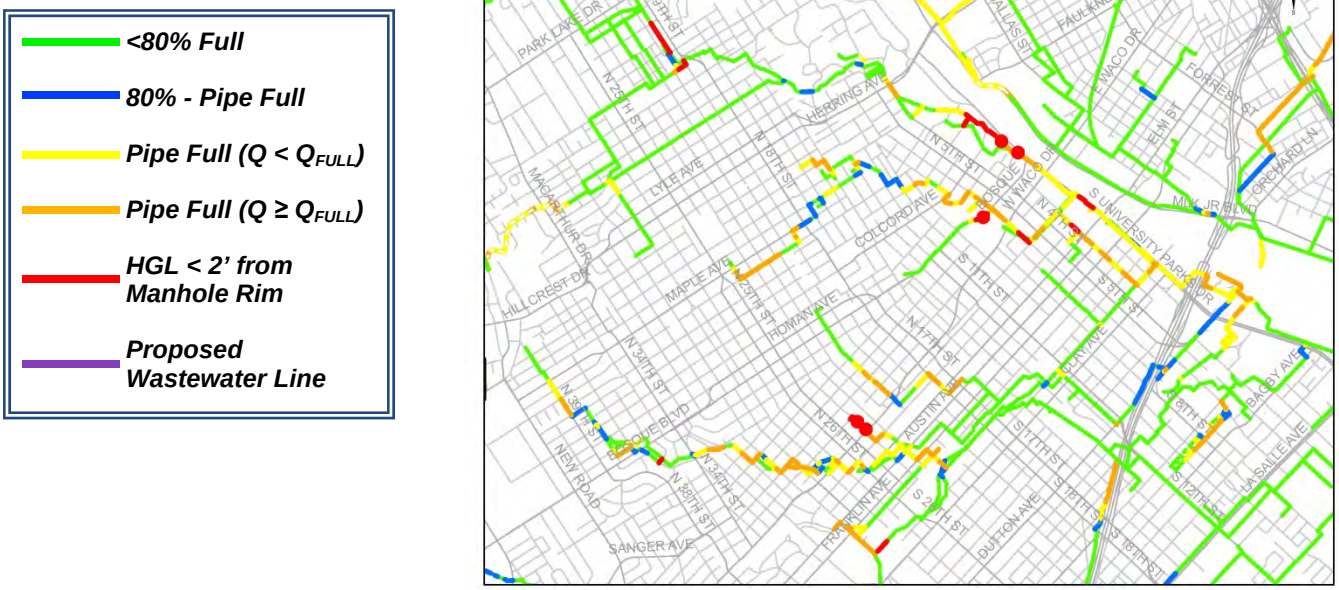
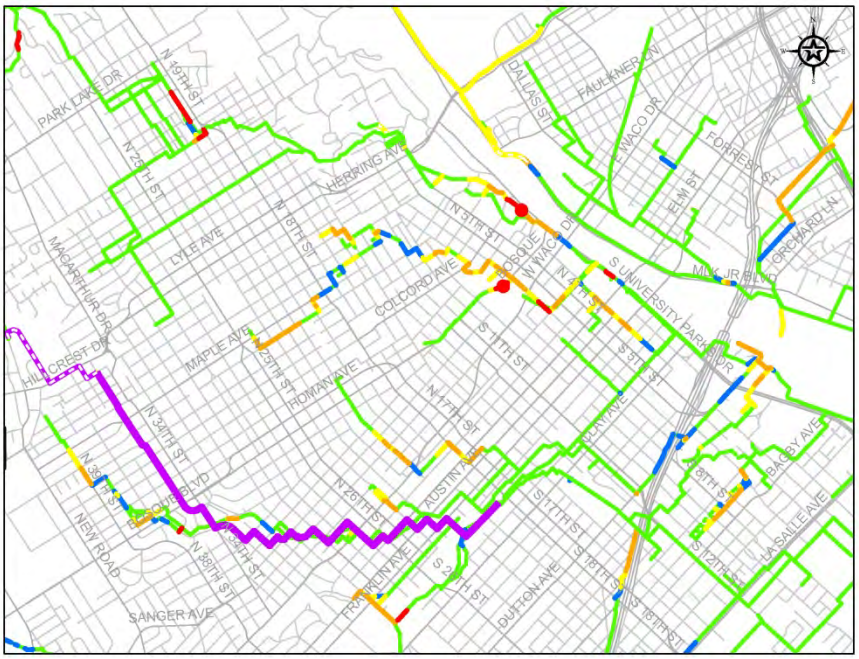


Figure 8-16: Project 7: 5-year, 6-hour model results – After Project



This project will abandon the existing Landon Branch Lift Station cast iron force main that is at the end of its original design life.

The existing Landon Branch Lift Station force main is an approximate 4,190 linear foot long 14-inch cast iron pipe that is about 45 years old. Water Utilities staff has indicated that the force main is likely near the end of its design life. The highest natural ground elevation of the force main is approximately 560' along the existing alignment and

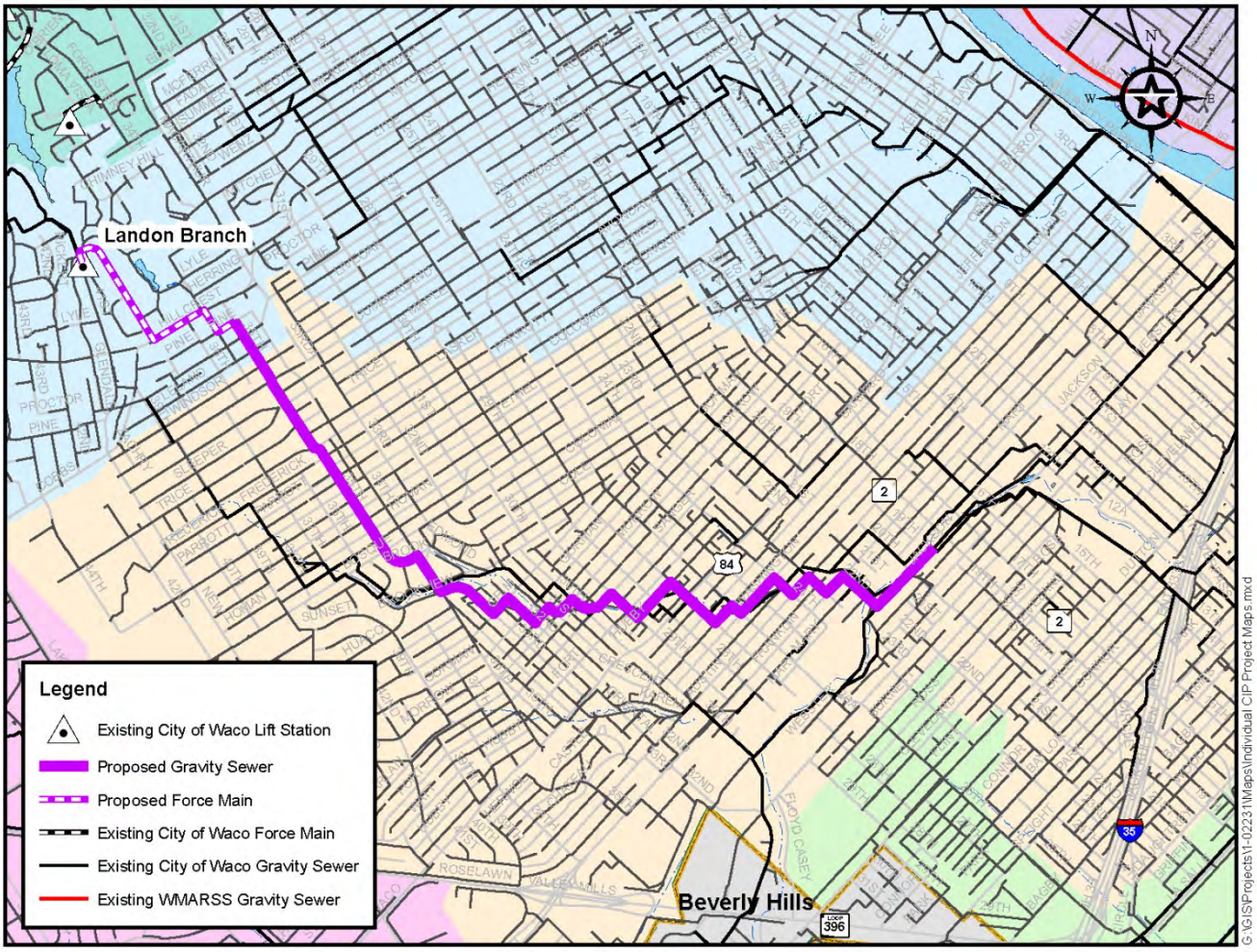
currently outfalls into a 15-inch diameter gravity line that generally runs along McKenzie Drive. The proposed force main alignment (reroute) will be approximately 3,925 linear feet in length with a highest natural ground elevation of approximately 555'. **Therefore, the operating conditions at the lift station should not be significantly impacted**.

It is expected that the final project profile will allow for the removal of aerial crossings that have been identified within the E. Brookview Drive and N. 34th Street area. Finally, it is recommended that the proposed line be sized in order to handle the future additional rerouted flows from the Wooded Acres Lift Station, Greenleaf Lift Station, Village Green Lift Station, Park Lake Lift Station and Chimney Hill Lift Stations. See the project descriptions for Projects 4 & 25 for additional overall project definition.

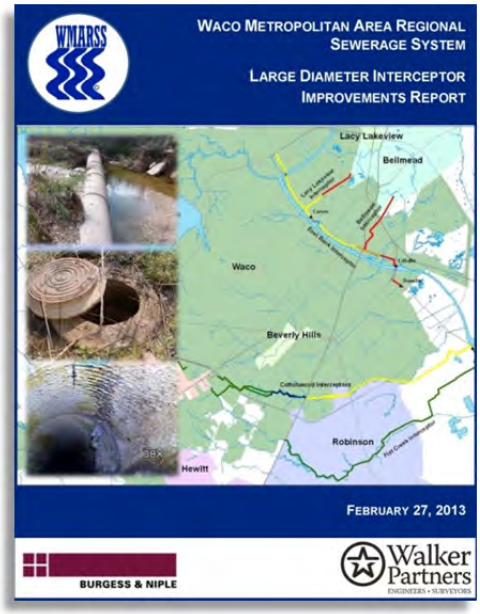
With the completion of the construction of the Brazos Basin Interceptor, the City will possess a long-term solution for providing more effective conveyance capacity within portions of the Barron's Branch, Twin Bridges, Brazos, Cottonwood, and Primrose Wastewater Basins.

At the conclusion of this project, it is then recommended that the Rehabilitation of Remaining Portions of West Bank Interceptor (Project 11) be completed. Once this project is complete, it will significantly reduce the required temporary bypass pumping capacity requirements for other required rehab in the basin. With the completion of the construction of the Brazos Basin Interceptor, the City will possess a long-term solution for providing more effective conveyance capacity within portions of the Barron's Branch, Twin Bridges, Brazos, Cottonwood and Primrose Wastewater Basins. Project 7 (Figure 8-17) is recommended for implementation in the year 2018. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 7 is $12,658,250.00. Appendix D presents the associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-17: Project 7: Brazos Basin Interceptor (Upper Limits) and Reroute of Landon Branch LS flows From West Bank Interceptor



8.3.8. Project 8: WMARSS Project No. 2 – Lacy Lakeview / Bellmead / TSTC Interceptor



This project will provide additional conveyance capacity in the northern portion of the WMARSS system in order to remove existing hydraulic bottlenecks that currently exist within the Lacy Lakeview, East Bank and Bellmead WMARSS Interceptors.

Project 8, as identified in the February 2013 WMARSS Large Diameter Interceptor Improvements Report, will include routing a new interceptor to service the northern portion of the Greater Waco Metropolitan Area (Lacy Lakeview, Bellmead, Texas State Technical College, and Waco areas) in order to provide additional conveyance capacity within the northern portion of the WMARSS system. **The preliminary alignment reroutes current and future wastewater flows away from the existing WMARSS northern interceptors (Lacy Lakeview, East Bank, and Bellmead).** The alignment of the proposed gravity interceptor will run generally west to east along a route located away from the Brazos River (away from the Brazos Alluvium and the Lake Brazos Dam water table). The interceptor is intended to remove existing hydraulic capacity bottlenecks within the Lacy Lakeview, East Bank, and Bellmead Interceptors. It will also provide needed additional capacity for future growth in the areas served by these interceptors. The proposed interceptor will outfall near the proposed LaSalle Lift Station (Project 1). **It is estimated that approximately 90-95% of Lacy Lakeview flows will be rerouted, 55-60% of Bellmead flows rerouted, as well as portions of Waco's collection system which includes Texas State Technical College (TSTC).** This project should not be initiated until such time that the East Bank flows are rerouted away from the Transfer Lift Station and additional pumping capacity is provided at the LaSalle Lift Station.

Major portions of the identified pipeline route will take advantage of existing rights-of-way and easements within the Cities of Bellmead and Waco. Portions of the interceptor will also run parallel to existing railroad rights-of-way. **The completion of this project will create opportunities to explore improved alternatives to replacing and/or rehabilitating remaining portions of the existing WMARSS Lacy Lakeview, East Bank, and Bellmead Interceptors.** The completion of this project is a major driver in the final determination of timing, scope, and construction of these subsequent projects.

At the time of completion of the Lacy Lakeview / Bellmead / TSTC project, the Team recommends that WMARSS consider removing the bulkhead from the 24" inverted siphon line on the Brazos (East Bank Interceptor). The 24-inch inverted siphon was constructed in 1970 at the same time that the 15-inch and 18-inch siphon lines were constructed. At the time the siphons were constructed, a bulkhead was installed that prevents the 24-inch pipe from receiving wastewater flows. The removal of the bulkhead could now be accomplished since the volume of flow rerouted away from the Carver Lift Station (formerly from the 24-inch Lacy Lakeview Interceptor) will be replaced by additional flows from the upstream Village Lake Basin. The hydraulic modeling as part of the master planning effort substantiates that little impact will be created at the downstream WMARSS Carver Lift Station as a result of both of these

projects being completed. The existing 15-inch and 18-inch siphon lines currently act as a choke point within the East Bank Interceptor and serves to effectively restrict wastewater flows contributed from the China Spring area. **WMARSS is currently engaged with a project that will allow for cleaning and other maintenance operations on the existing 15-inch and 18-inch siphon lines.** Prior to the implementation of the upcoming project, these activities have historically been impractical at best and impossible at worst.

The existing 15-inch and 18-inch siphon lines currently act as a choke point within the East Bank Interceptor.

A final benefit of this project is that at its completion the accuracy of the WMARSS metering for both the Cities of Bellmead and Waco will be significantly improved. Currently, the flows are commingled upstream of the Bellmead metering manhole and does not allow for the accurate measurement of the City of Waco flows at this location.

Figure 8-18: Project 8: 5-year, 6-hour model results – Before Project

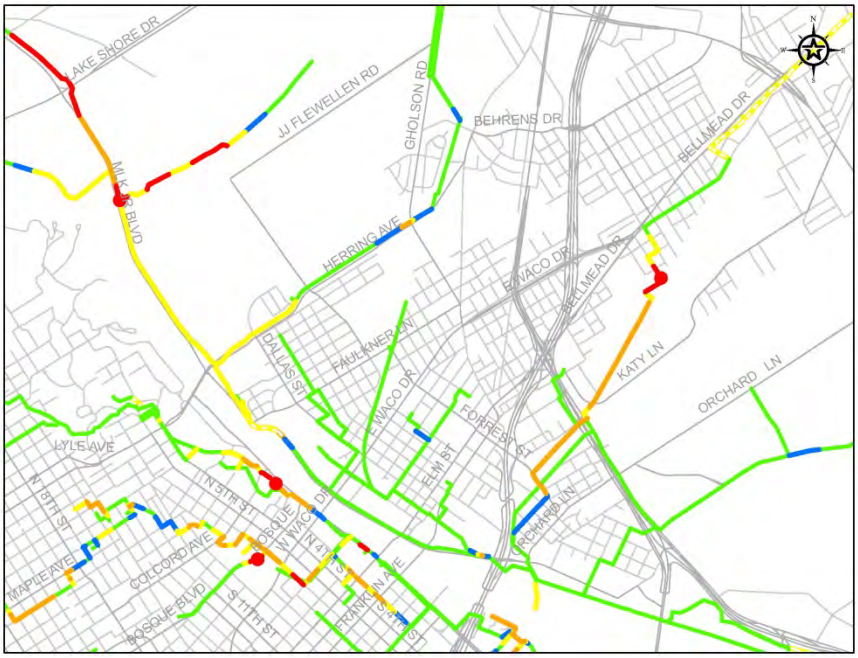


Figure 8-19: Project 8: 5-year, 6-hour model results – After Project

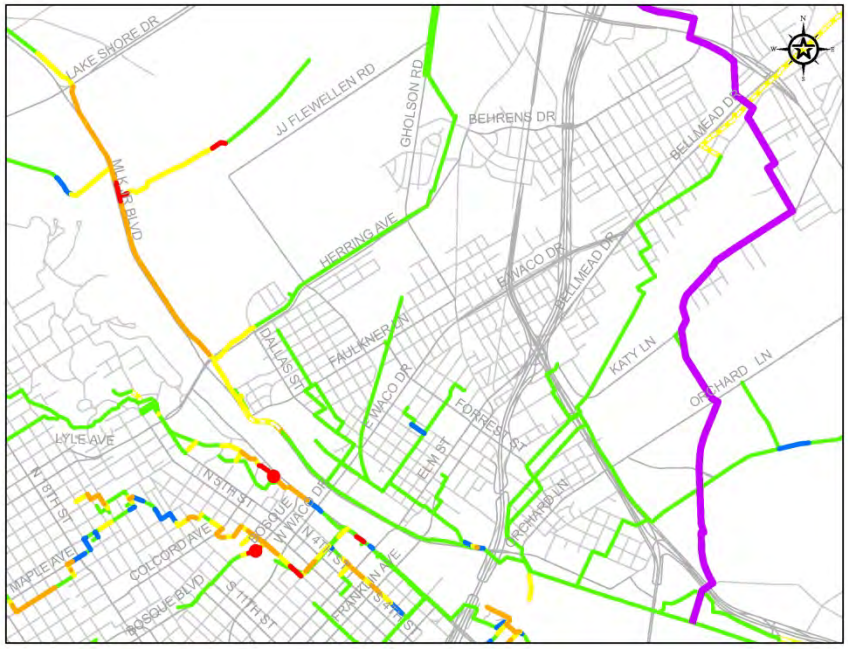


Figure 8-20 shows the project alignment as proposed in the 2013 WMARSS Large Diameter Interceptor Improvements Report. Since that time, further evaluation has cultivated a second potential alignment. Figure 8-21 shows this second alignment which has the added benefit to the City of Waco of allowing for the abandonment of the Lincoln Park and Chicken Shack Lift Stations (refer to Figure 7-1 Project 9). Based upon this benefit, it is currently recommended that this is likely a preferred alignment as compared to the original WMARSS alignment. However, this alignment option will correspondingly require additional improvements as part of Project 15. Project 8 (to include either Figure 8-20 or Figure 8-21) is recommended for implementation in the year 2018. Easement acquisition will be required for the identified improvements. The WMARSS Large Diameter Interceptor Improvements Report included an estimated project cost for Project 8 of $11,829,000.00. The City of Waco participation amount (currently @ 75.3%) is $8,908,000.00.

Figure 8-20: Project 8: WMARSS Project No. 2 – Lacy Lakeview / Bellmead / TSTC Interceptor (WMARSS Alignment)

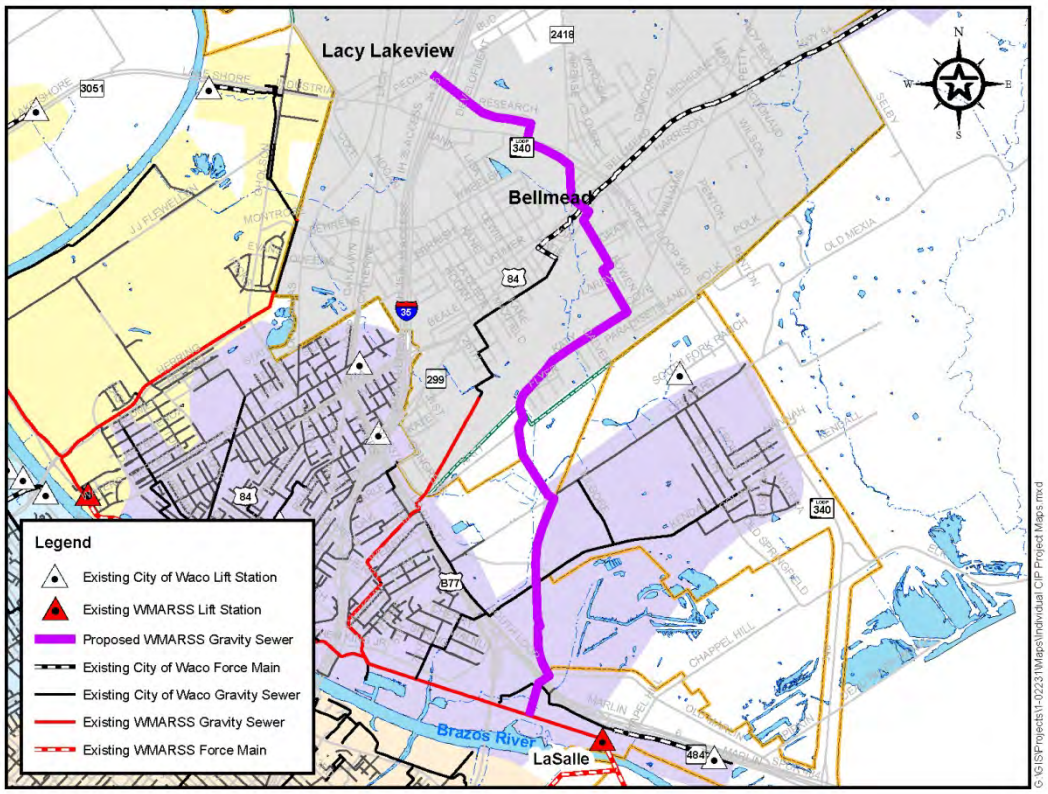
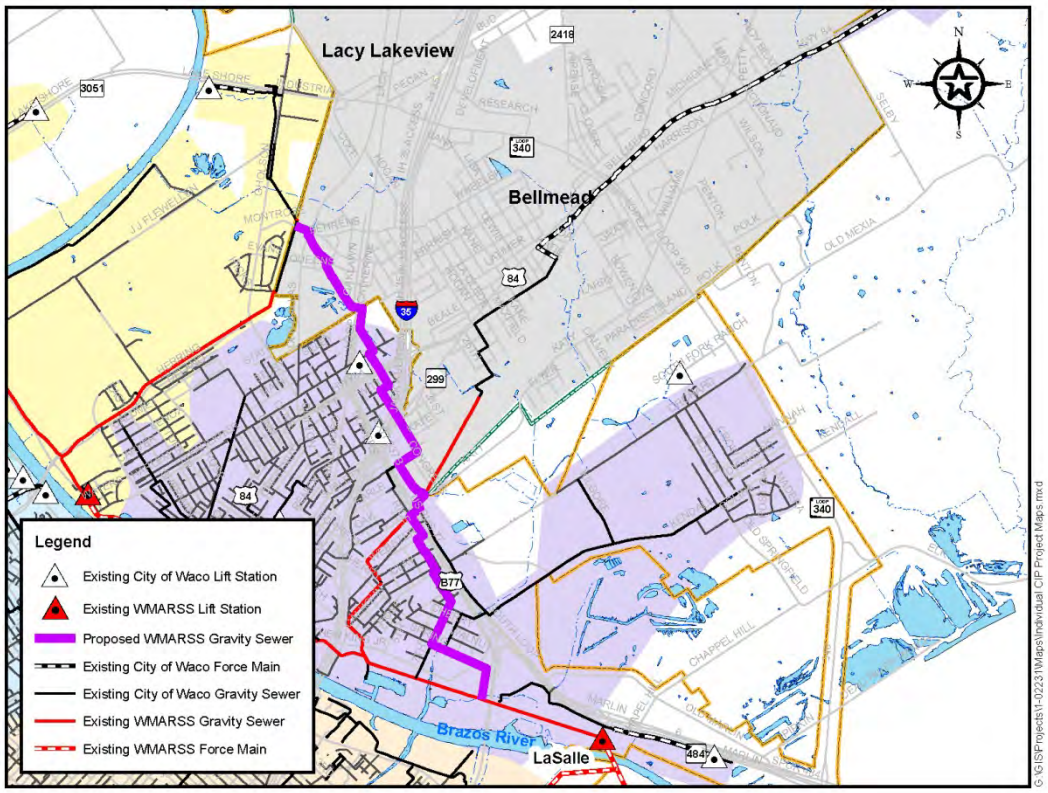


Figure 8-21: Project 8: WMARSS Project No. 2 – Lacy Lakeview / Bellmead / TSTC Interceptor (Optional Alignment)



8.3.9. Project 9: Church Road Lift Station Added Capacity and Force Main Replacement

Church Road Lift Station

Project 9, as proposed herein, will address both firm pumping capacity and force main condition concerns. **The proposed lift station improvements will consist of additional pumps at the existing site to increase the current firm pumping capacity.** The Church Road Lift Station and its associated 14,900 linear foot 12-inch ductile iron force main were constructed in 2000. Water Utilities staff has indicated that both the lift station and the force main are in very poor condition requiring continuous and ongoing maintenance for their field staff. There is some controversy associated with the force main construction methods. Water Utilities staff believes that the existing force main was not poly-wrapped during installation. On the other hand, the Contractor that installed the force main has stated that the pipe was poly-wrapped. He has also stated that the pipe installed is TJ PR350 epoxy lined ductile iron pipe. **The combination of both corrosion and high pressures (existing station has a head of approximately 330 ft) in the force main line contributes to numerous problems**. A majority of the existing force main is located within the pavement section of the Cottonbelt Trail. Therefore, the routing of a new force main will prove challenging. Additionally, the current station is inundated by inflow and infiltration during wet weather events. Water Utilities staff has conveyed that overflows have been observed upstream of the lift station. Staff has also conveyed that they are affected by recurring maintenance that is required due to the alleged poor structural condition of the existing force main. Therefore, it is advised that the existing force main be addressed in the not-to-distant future. **Waco staff considers both the lift station and force main to be high priority.**

Immediate Need Lift Stations
Church Road
Green Leaf
Village Lake

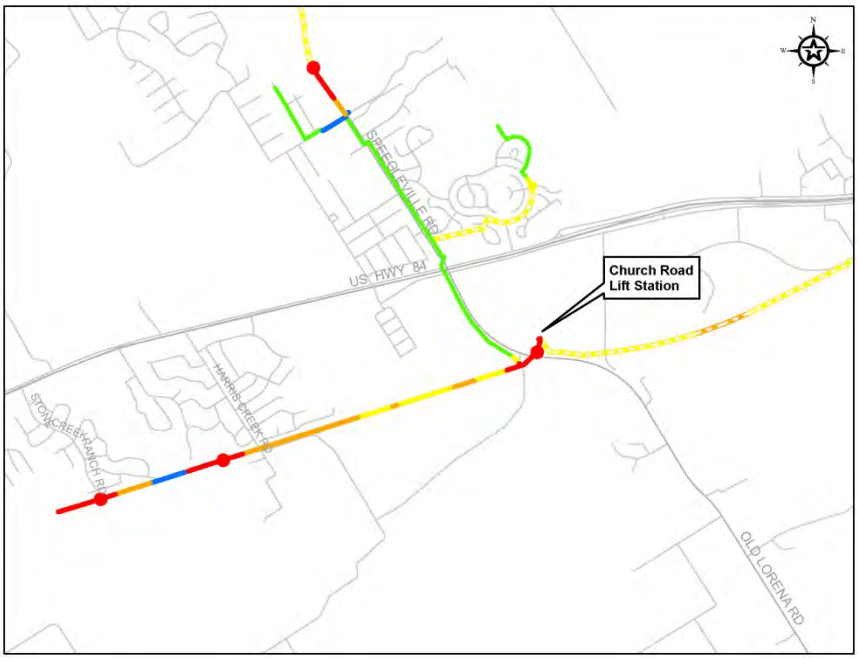
Water Utilities staff has indicated that both the lift station and the force main are in very poor condition requiring continuous and ongoing maintenance.

The current Church Road Lift Station operates as a duplex station. With one pump running, the firm pumping capacity is reported to be 1,100 gpm. The station is set up so that both pumps do not pump at the same time. **The existing station was originally designed to add future additional pumps in order to increase the station's firm pumping capacity.** The current average dry weather flow is estimated to be approximately 310 gpm. The peak wet weather flow is estimated to be greater than 1,100 gpm based upon observed upstream SSO's. A meter was not placed within the Speegleville Basin as part of the temporary flow monitoring due to the fact that the Church Road Lift Station was constructed in 2000 as a Brazos River Authority Project and the accompanying upstream gravity system was built after the completion of this project. Therefore, the collection system in the Speegleville Basin is less than 15 years old, is composed of PVC pipe, and would generally be considered to be the most watertight basin within Waco's collection system. It is recommended that before the final lift station design is initiated that temporary flow monitoring be performed to assist in determining existing peak flow.

The Speegleville Basin collection system is less than 15 years old, is composed of PVC pipe, and would generally be considered to be the most watertight basin within Waco's collection system.

Since 2000, eight (8) additional lift stations have been installed upstream of the Church Road location (See Figure 2-6: Lift Station Map). These lift stations include Hwy 84, Stone Creek, Harris Creek, Ledgestone, Buckingham, Riverside, River Park, and Twin Rivers. Approximately 4% of the current total sewer service connections within the system are located upstream of the Church Road lift station.

Figure 8-22: Project 9: 5-year, 6-hour model results – Before Project



<80% Full

80% - Pipe Full

Pipe Full ($Q < Q_{FULL}$)

Pipe Full ($Q \geq Q_{FULL}$)

HGL < 2' from Manhole Rim

Proposed Wastewater Line

Figure 8-23: Project 9: 5-year, 6-hour model results – After Project

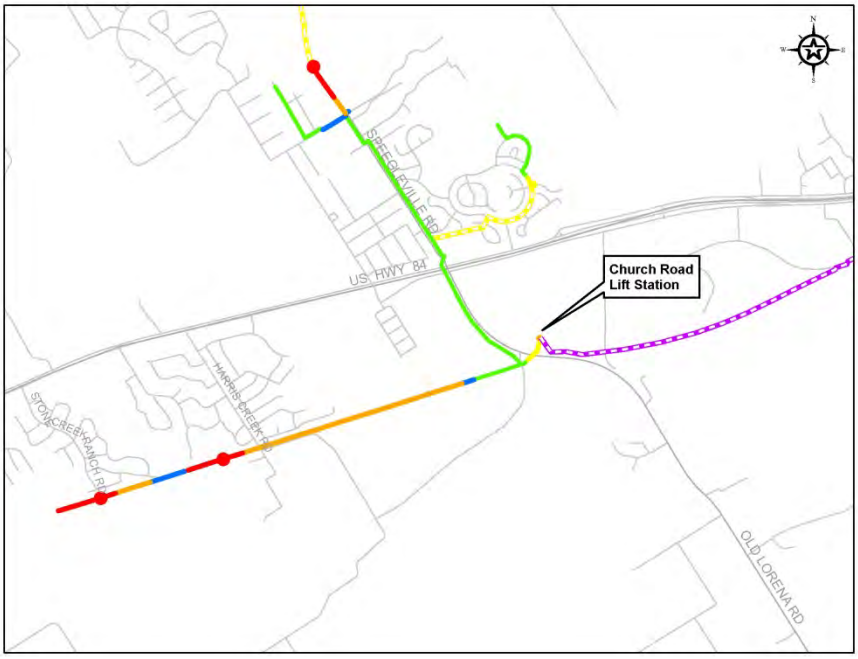


Figure 2-20: Speegleville Asset Renewal Area (Blue) Identified by Water Utilities Staff (Page 2-51)

Project costs were evaluated for the Speegleville Basin for two potential alternatives.

1. Reroute of Flows to Bull Hide Interceptor / WWTP and Add Capacity / Force Main Replacement at Church Road. This alternative includes Project 6 (refer to Section 8.3.6) and Project 9.

2. WWTP Option – This alternative would abandon the Church Road Lift Station and construct a wastewater treatment plant in the Speegleville Basin. Since the future City of McGregor wastewater option (of potentially either becoming a City of Waco customer or a WMARSS member) has not been resolved at this time, this alternative should be fully vetted so that Waco, McGregor, and WMARSS fully understand any and all potential ramifications. With a pending decision not appearing to be a near term reality, it is difficult to advise that the City spend the money to immediately build a treatment plant in this area. However, when considering that long-term, substantial growth is projected within the Speegleville Basin and that the City of McGregor may additionally contribute wastewater flows, the option of siting a treatment plant in this area of Waco's system appears to be sound. Refer to Section 7.3.5. for additional discussion.

The evaluation performed as part of the master planning effort should not be considered an in-depth analysis. It is recommended that the City have a preliminary engineering study done to further evaluate. The master planning evaluation anticipates a project cost for the first option to be 40% to 50% of the cost of the second option. Based upon this conclusion, the Master Plan recommendation is that the City carry out the first option. At such time that growth within this portion of the system exceeds a peak wet weather flow of 3.0 MGD, the WWTP option should be initiated.

This portion of the wastewater collection system is rather involved and complicated. Alternative 1 discussed above has several options that should be fully vetted within a detailed engineering study before the City can proceed in confidence that they are pursuing the most cost effective and constructible alternative in the short term.

A. Evaluate the option of installing a portable packaged system to produce effluent water for reuse at the Twin Rivers Subdivision / Golf Course, the City of Waco Landfill, or directed back into Lake Waco. Each of these areas are located in close proximity to the Church Road Lift Station. Choosing to move forward with a portable packaged system would reduce the pumping requirements at the Church Road Lift Station while assisting in preserving capacity within the WMARSS Bull Hide Wastewater Treatment Plant.

B. Upsize (replace) the existing Cloice Creek Lift Station with a new, larger station that would allow the Church Road Lift Station to direct flow to the new Cloice Creek Lift Station, which will subsequently pump to the current outfall location. It is understood that this option was the originally recommended alternative to the City about a decade ago. A copy of the Technical Memorandum as part of this effort was not located as part of the master planning effort. However, prior to the final design and construction of the 2011 Cloice Creek Lift Station improvements, the original recommendation was amended. Proceeding with this option at this time still produces a number of benefits to the City. First, it would allow a much less complicated replacement of approximately 40% of the lower segment of the existing force main. Second, this option would allow the replacement Cloice Creek Station to be designed to utilize the existing parallel 6-inch and 12-inch force mains. Should future visual structural condition testing of the force main confirm that replacement is warranted at the time the lift station construction, it should be replaced. However, should the future visual structural condition testing determine that the existing 12-inch force main of the upper segment could continue to be utilized, the new Cloice Creek Lift Station force main configuration would allow the pipeline to be over 6,000 linear feet shorter than its current configuration. The force main would additionally have approximately 40 vertical feet of head removed, thereby significantly reducing the operating pressures that are currently exerted on the force main. This final determination can only be verified after visual condition testing is performed.

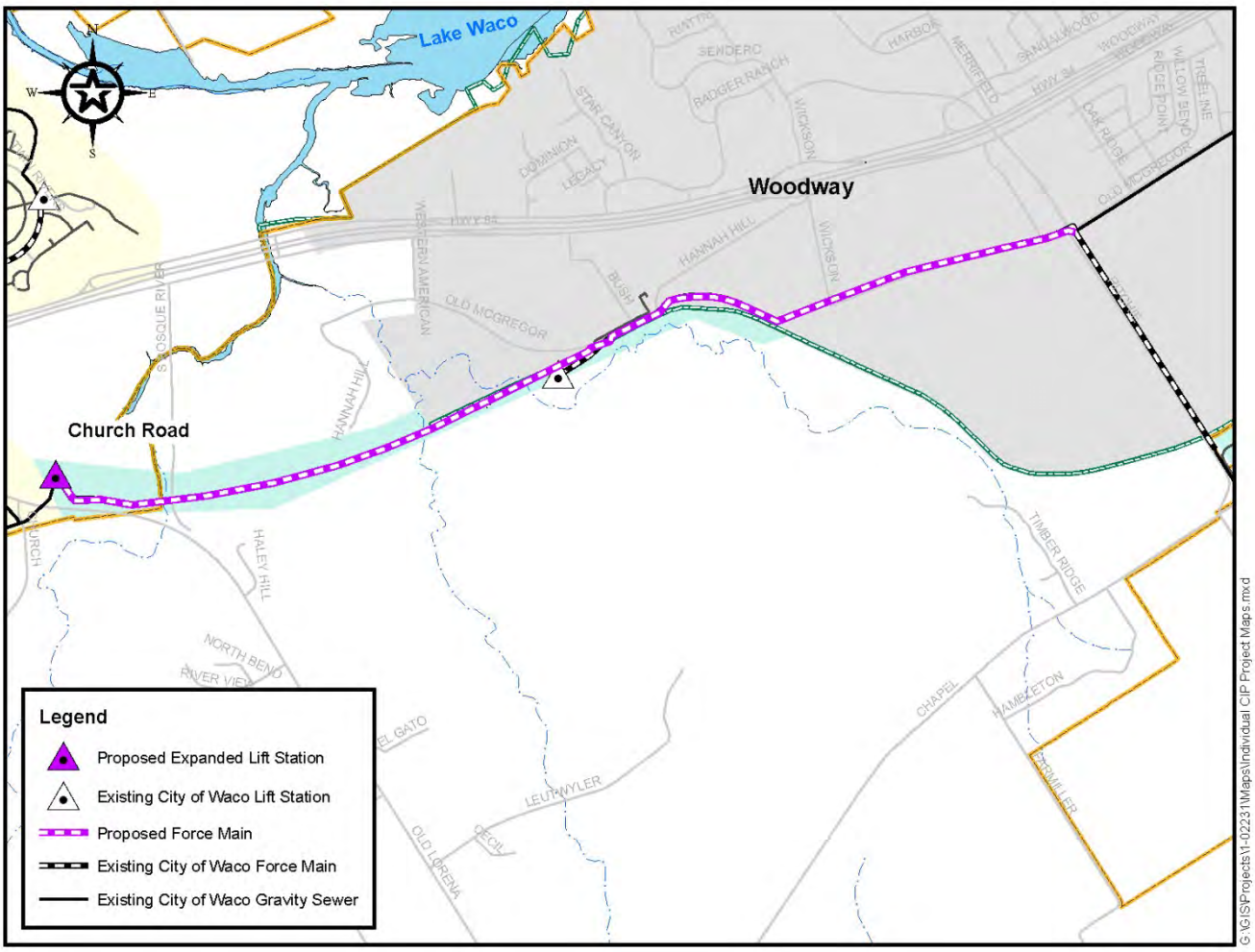
C. The option of utilizing the 6-inch force main during the time that the existing 12-inch force main is rehabilitated warrants further evaluation. Due to the fact that the existing force main is approximately 2.8 miles in length, temporary bypass pumping is virtually impractical. The existing 6-inch force main is valuable to this portion of the collection system. Another advantage this force main provides is that at such time that a WWTP is constructed, this force main could be used to pump the biosolids and non-reclaimable wastewater to the WMARSS Bull Hide Treatment Plant.

D. Even as part of an option that includes a new Cloice Creek Lift Station, the existing Church Road Lift Station will require rehabilitation. The elevation head of the existing station will be reduced from approximately 270 vertical feet to 40 vertical feet. It is anticipated that the current submersible pump/booster pump configuration can to be reconfigured to a submersible station.

This project should be constructed only after Project 6 is completed (Reroute Church Road Lift Station flows from South Flat Creek wastewater line to Bull Hide/Castleman Creek wastewater line). The cost included as part of this effort includes the cost of a lift station and 15,000 linear foot of new force main.

Project 9 (Figure 8-24) is recommended for implementation in the year 2019. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 9 is $4,441,700.00. Appendix D presents the associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-24: Project 9: Church Road Lift Station Added Capacity and Force Main Replacement

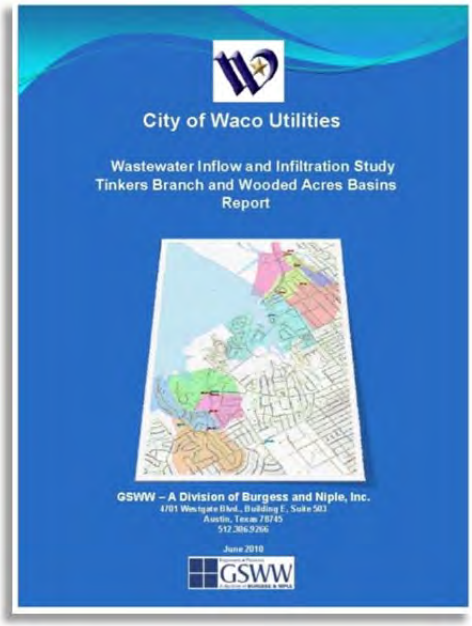


THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.10. Project 10: 2019-2022 Asset Renewal Project No. 2 – Replace / Rehabilitate structurally deficient existing small diameter lines

This project will replace approximately 140,000 linear feet of existing pipe that is currently in very poor structural condition and in need of replacement.

Project 10, as proposed herein, will provide for the replacement of approximately 140,000 linear feet (or roughly 4.0% of the total length of the collection system) of existing pipe (primarily vitrified clay tile lines) that is currently in very poor structural condition. **By responsibly rehabilitating and/or replacing structurally deficient small diameter collection lines, the City will preserve existing system hydraulic capacity for future growth as well as reducing the City's cost of paying for excessive wet weather treatment and transportation.**



The lines should be selected based upon Sanitary Sewer Assessments, temporary flow monitoring prioritization, work orders, closed circuit television inspection data, and/or historical and institutional knowledge. The City should also utilize the Tinkers Branch and Wooded Acres Basins Wastewater Inflow and Infiltration Study Report (previously discussed in Chapter 2) as well as reference Chapter 7, Section 7.1. Future Sanitary Sewer Assessments (SSA's) for making the final selection of deficient locations. SSA's greatly assist in pinpointing structurally deficient lines as well as identifying inflow and infiltration locations to reduce the excessive peak wet weather flows within both the older portions of the City's collection system and the WMARSS collection system. Based upon availability, City staff may choose to perform a portion of the required CCTV services in-house in order to assist in controlling costs.

The Hillcrest Lift Station should be evaluated for consideration for inclusion as one of the asset renewal projects. The Hillcrest Lift Station was evaluated within *Chapter 6: Lift Station Evaluations*. Additionally, the City may choose to include other "small" lift stations for rehabilitation or replacement as part of this project. **As discussed in Chapters 2 and 6, these "small" lift stations have an overall lower risk impact to the City should failure occur; however, each of these stations will require rehabilitation or replacement as they continue to age in order for the City to maintain or improve the systems current operating benchmark.** Table 2-9: Lift Station Summary provides the original construction date for each lift station within the collection system. It is generally recognized that the estimated life expectancy of a lift station is approximately 30 years. Per Table 2-9, Bosqueville, Chicken Shack, Lincoln Park, Tinkers Branch and Windmill Hill are "small" lift stations that have been in service for more than 30 years and should be considered for rehabilitation.

Offset joint and pipe cracking along a clay tile sewer line.

Project 10 is recommended for implementation in the year 2019. The final limits of the Project 10 improvements will not be determined until further investigations are completed. Easement acquisition is anticipated for many of the identified asset renewal improvements.

The total estimated project cost for Project 10 is $35,000,000.00. No project map is associated with this project since the target segments have not yet been located.

8.3.11. Project 11: West Bank Interceptor Rehabilitation (Part 2)

It is believed that the segments identified as part of this project were originally constructed in the early 1950's with reinforced concrete pipe.

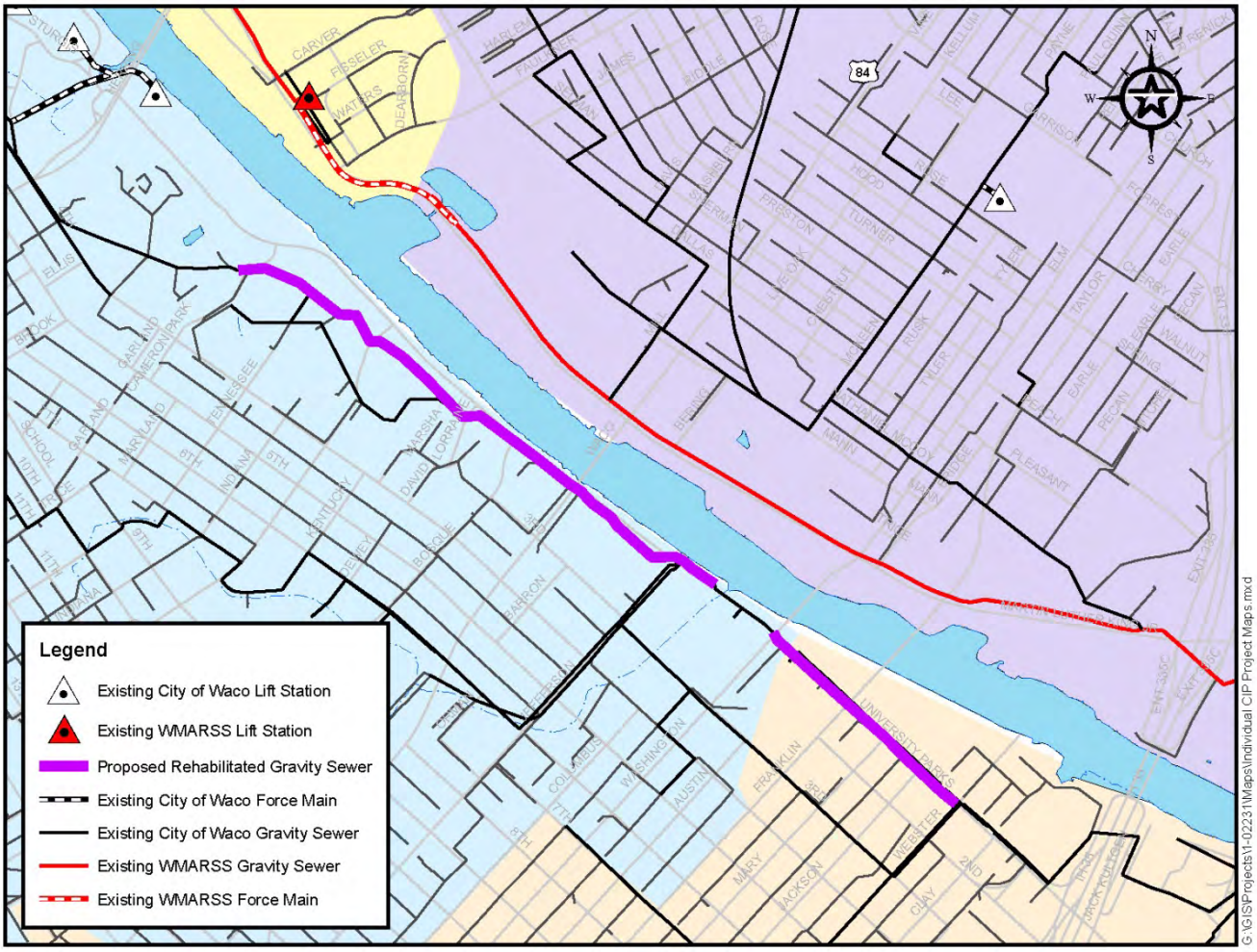
Project 11, as proposed herein, will rehabilitate segments of the West Bank Interceptor by cured-in-place or slipline methods. The proposed upper and lower project limits are from Webster Avenue to Cameron Park Drive. The two segments of the West Bank Interceptor are 30-inch and 36-inch in diameter and were originally constructed in the early 1950's with reinforced concrete pipe. Therefore, these lines are currently approximately 60 years old. **City staff has indicated that this segment of line is in very poor condition and warrants immediate attention.** It is recommended that Water Utilities staff perform closed circuit television inspections of these segments as soon as possible. Since the existing West Bank Interceptor is located within both the Brazos Alluvium and Lake Brazos water table, construction by removal and replacement of the line along the existing alignment would be difficult.

WMARSS East Bank Interceptor near Baylor Football Stadium - photo showing caving of trench walls due to existing alluvial soils.

By rehabilitating the line using cured-in-place or slipline methods, the internal diameter of the existing pipe will be decreased thereby decreasing the conveyance capacity within this segment of the line. Add to this the fact that the West Bank Interceptor currently has inadequate hydraulic capacity. Therefore, **Projects 4 and 7 (the Brazos Basin Interceptor) should be completed prior to this project.** This project should be constructed only after Project 7 (Brazos Basin Interceptor- Upper Limits) has been completed, so that the Landon Branch Lift Station flows will be rerouted away from the West Bank Interceptor and the West Bank Interceptor should realize a flow reduction of 2,300 gpm during wet weather events. This will free up available capacity within the West Bank interceptor and allow for the proposed rehabilitation strategy to be considered responsible (the decrease of the nominal diameter of the pipe and its effect on the associated hydraulic capacity). **The removal of the Landon Branch flows will additionally reduce the temporary bypass pumping setup that will be required to successfully complete the work.**

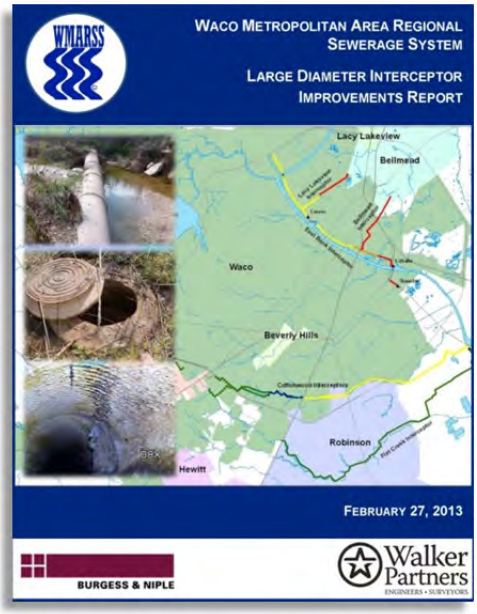
Project 11 (Figure 8-25) is recommended for implementation in the year 2020. Easement acquisition is not anticipated for the identified improvements. The total estimated project cost for Project 11 is $2,362,750.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-25: Project 11: West Bank Interceptor Rehabilitation (Part 2)



8.3.12. Project 12: WMARSS Project No. 3 – Rehabilitate Bellmead Interceptor

Project 12, as identified in the February 2013 WMARSS Large Diameter Interceptor Improvements Report, will include either open cut replacement or trenchless pipe rehabilitation of the WMARSS Bellmead Interceptor from Peach Street (near Martin Luther King) to the northernmost limits of the Interceptor. **It is generally understood that a majority of the WMARSS Bellmead Interceptor is currently in very poor structural condition.**

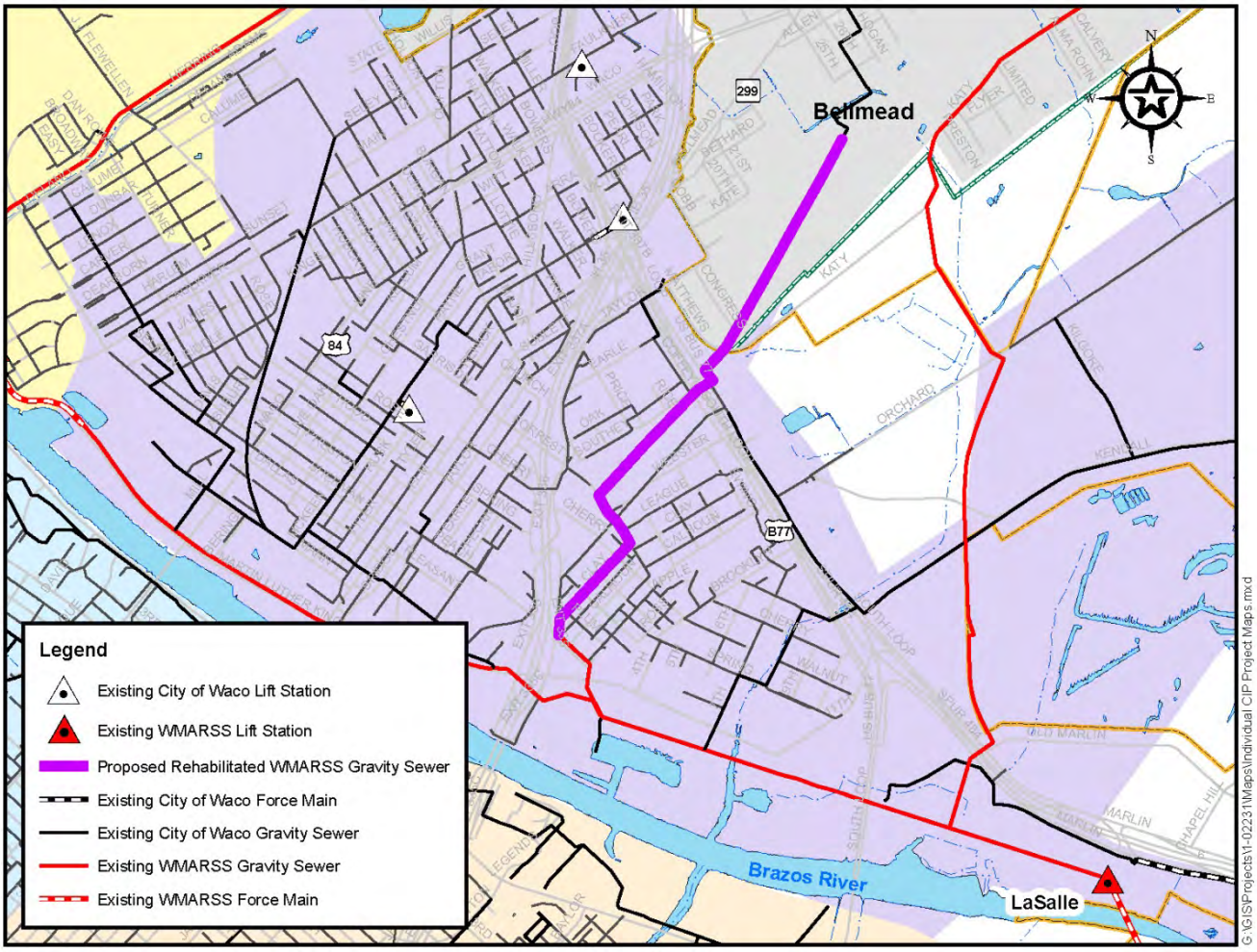


The southern portion (from southern limit of interceptor to US 77) of the existing line should be closely evaluated for rehabilitation using liner pipe. This strategy can be employed since the hydraulic bottleneck that currently exists will have been removed with the completion of Project 8 (Lacy Lakeview / Bellmead / TSTC Interceptor). The northern portion (from northernmost limit of the Interceptor to US 77) should be closely evaluated for replacement by open cut construction. The northern portion of the existing Bellmead interceptor was originally constructed on a very flat grade and previous Sanitary Sewer Assessment studies have indicated that sags currently exist within this portion of the line. **Over time, this segment of pipe near the Baylor Research and Innovation Collaborative (BRIC) has accumulated a significant amount of debris in the bottom of the pipe.** The southernmost portion of the Bellmead Interceptor (approximately 1,300 LF) was replaced in 2012 as part of the construction of the McLane Football Stadium.

Project 12 (Figure 8-26) is recommended for implementation in the year 2020. Easement acquisition is anticipated for the identified improvements. The WMARSS Large Diameter Interceptor Improvements Report included an estimated project cost for Project 12 of $2,893,000.00. The City of Waco participation amount (currently @ 75.3%) is $2,179,000.00.

Existing pipe condition of the WMARSS Bellmead Interceptor

Figure 8-26: Project 12: WMARSS Project No. 3 – Rehabilitate Bellmead Interceptor



8.3.13. Project 13: Reroute of Wooded Acres Lift Station Flows from Cottonwood Basin to Brazos Basin Interceptor

This project will reroute the Wooded Acres Lift Station flows from the Cottonwood Basin to the proposed Brazos Basin Interceptor.

Project 13, as proposed herein, will address condition concerns related to the existing 8,900 linear foot 12-inch Wooded Acres force main that was installed in 1999. **It is proposed that the flows be rerouted such that the new force main bypasses the Landon Branch Lift Station and pumps directly to the proposed Brazos Basin Interceptor.**

Prior to 1999, the Wooded Acres Lift Station conveyed flows via a force main to the Landon Branch Lift Station, which successively routed flows to the West Bank Interceptor. It is understood that this reroute was primarily carried out in order to decrease the frequency and volume of overflows along the West Bank Interceptor. As a result of the 1999 reroute, City staff conveyed that they believe the overall volume of overflows has decreased along the West Bank Interceptor, thus hydraulically improving this area of the collection system. However, as a result of the force main discharge being transferred to the Cottonwood Basin, existing rainfall driven SSO's that occur in the Cottonwood Basin (upstream of Valley Mills Drive (Genie Car Wash) and up to Bosque Boulevard (HEB and Target areas)) has been exacerbated. Water Utilities staff confirmed that the segment of the wastewater system described above is severely overloaded during wet weather events. This was confirmed during the Chapter 2 (Historical / Institutional Knowledge) and Chapter 4 (Temporary Flow Monitoring) efforts. **Therefore, rerouting the Wooded Acres Lift Station flows through the new Brazos Basin Interceptor will provide an improved long-term solution for conveying the flows through the collection system and to the Central Plant.**

Water Utilities staff has conveyed that they experience significant maintenance problems with the existing force main and have indicated that they believe this force main is in very poor condition. Water Utilities staff conveyed that on more than one occasion, when the existing Wooded Acres force main has ruptured, that they have temporarily rerouted the lift station flows back into the "old/abandoned" force main as the temporary bypass line until the current force main was repaired.

Section 7.3.3, Mt. Carmel Backwash Filter, provides additional detail regarding potential future alternatives at the Mt. Carmel Plant.

One possible reason for the poor condition of the existing force main is related to the City's Mt. Carmel Water Treatment Plant. The Wooded Acres Lift Station and force main is located just downstream of the Mt. Carmel Water Treatment Plant. The Plant has a backwash filter pump station that discharges the Plant's backwash flow to the Wooded Acres Lift Station (See *Section 7.3.3 Mt. Carmel Backwash Filter* for additional detail). During the period from 1999 to 2011, the backwash discharge produced significant adverse effects on the lift station. **Water Utilities personnel conveyed that they had tremendous challenges with the lift station pumps which included the frequent replacement of the pumps because of the**

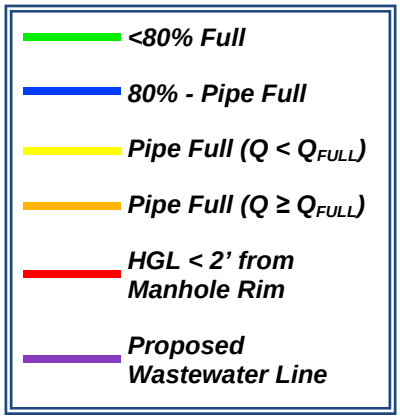
Large amounts of carbon that were backwashed from the Mt. Carmel Water Treatment Plant from 1999 to 2011 adversely affected the Wooded Acres ductile iron force main thus initiating premature deterioration.

carbon (sediment) that was being discharged from the backwash filter pump station (Staff indicated the replacements were on the order of one pump per month). In early 2011, the Dissolved Air Flotation (DAF) Plant improvements were completed significantly reducing the amount of carbon that had previously been needed as part of the water treatment process. Staff has conveyed that since 2011 the performance of the pumps at the Wooded Acres Lift Station have markedly improved. However, during the same 1999 to 2011 timeframe, the same carbon dosing (sediment) that adversely affected the lift station pumps also negatively affected the Wooded Acres ductile iron force main, thus initiating premature deterioration. **Water Utilities staff should perform a condition assessment on the Wooded Acres force main to verify its current structural condition before proceeding with the construction of this project.** Condition assessments were not within the scope of this master planning effort. However, without performing a thorough analysis, the current structural condition is unknown. One such option that Water Utilities could consider is to identify two or more locations (either a high maintenance location or location near a high point in the line) where the force main could be dug up and a joint of the existing force main be removed in order to provide an indication of the condition of the existing line and determine if the existing ductile iron line was polyethylene encased (poly-wraped). If not, structural condition problems could be related to the external surface of the pipe from "hot" soils. A final option is to evaluate if portions of the existing force main are located where nearby electrical currents could adversely affect the line.

Wooded Acres Lift Station

Water Utilities staff considers the existing lift station to be in good condition and have acceptable pumping capacity. As part of project, the existing pumps need to be evaluated to determine if they require replacement due to changed operating characteristics.

Figure 8-27: Project 13: 5-year, 6-hour model results – Before Project



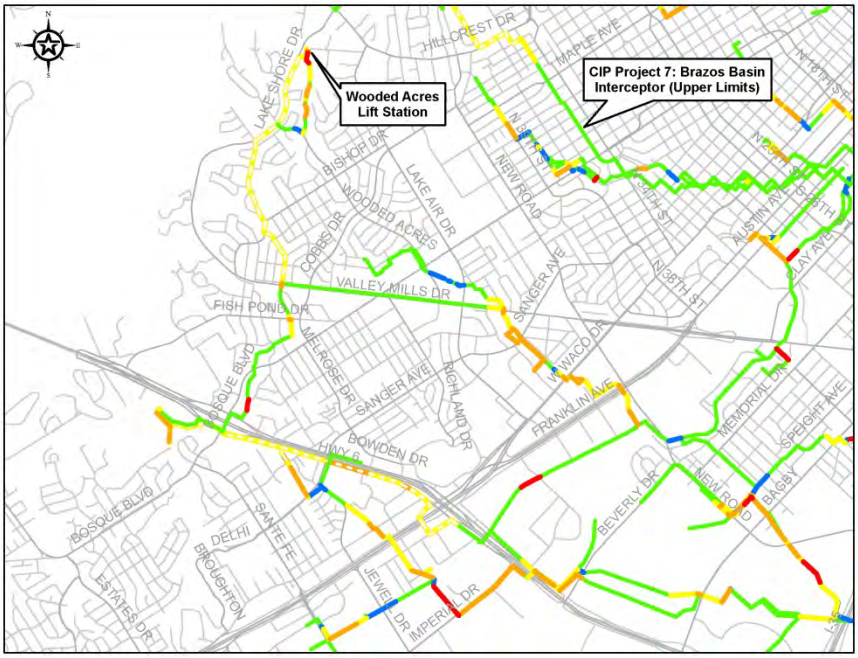
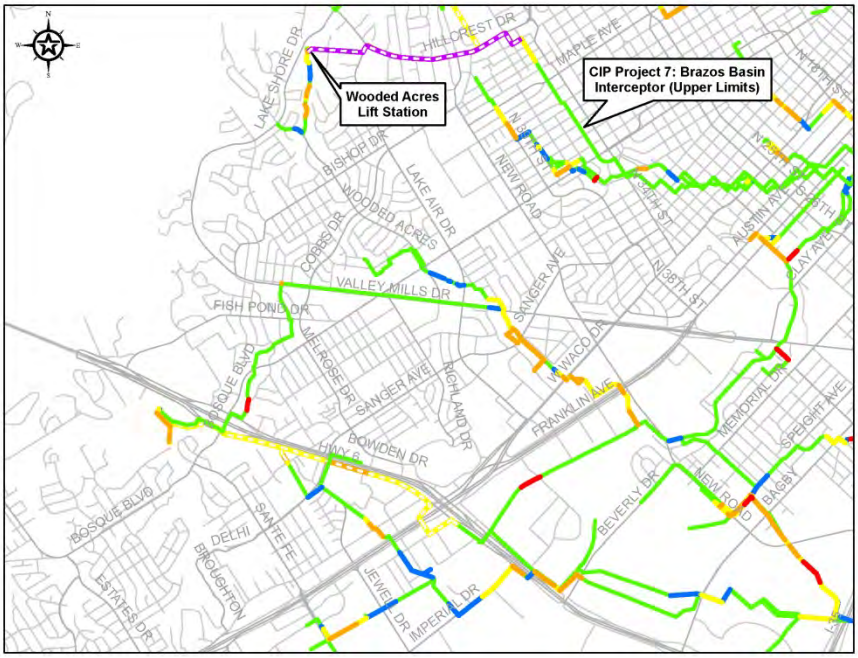


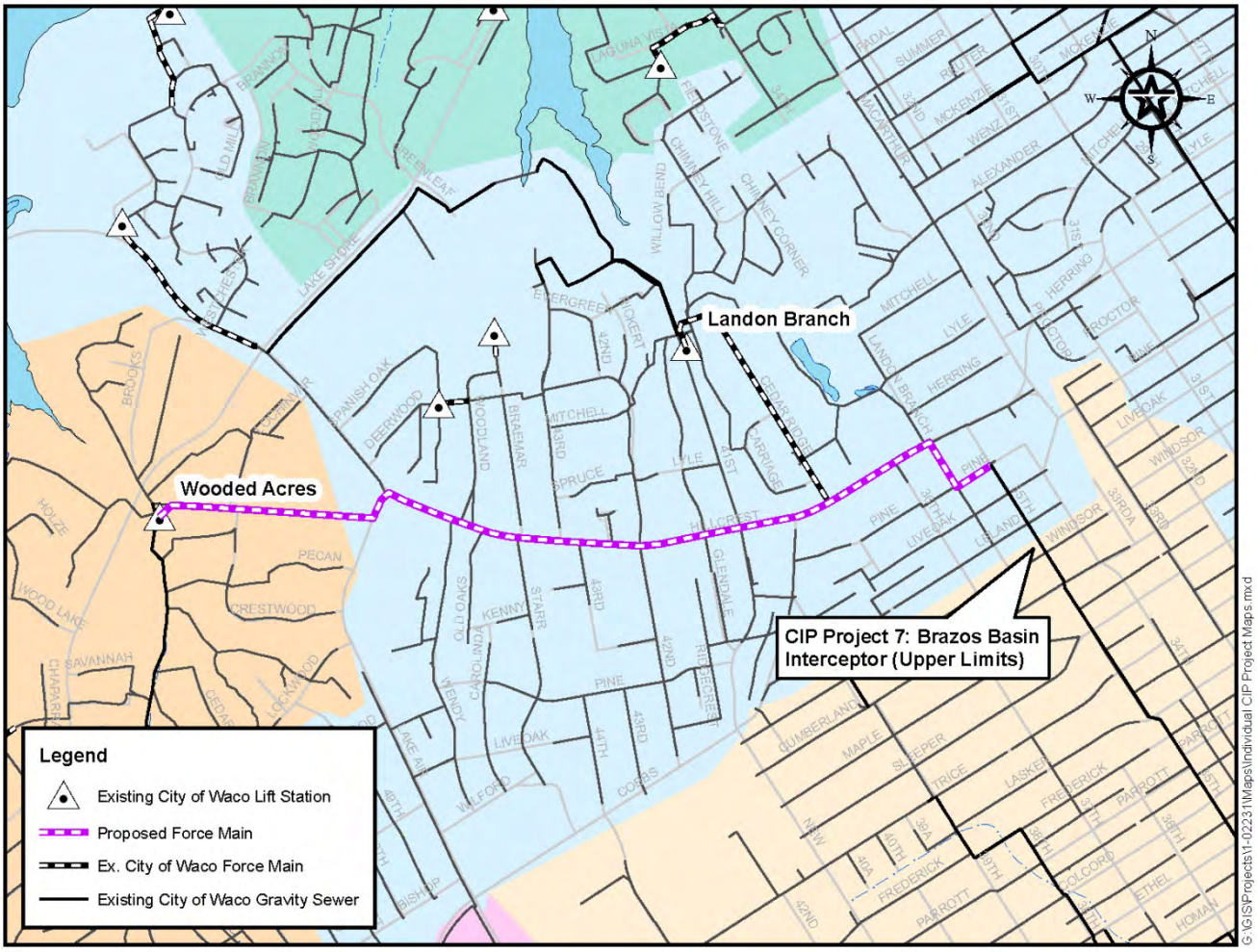
Figure 8-28: Project 13: 5-year, 6-hour model results – After Project



The completion of this project will give the City a long-term solution to provide more effective conveyance capacity within portions of both the Twin Bridges and Cottonwood Wastewater Basins. Project 13 (Figure 8-29) is recommended for implementation in the year 2020. This project should be constructed only after Project

7 (New Brazos Interceptor (Upper Limits) is completed. Minor easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 13 is $1,626,525.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-29: Project 13: Reroute of Wooded Acres Lift Station Flows from Cottonwood Basin to Brazos Basin Interceptor



8.3.14. Project 14: Added Pumping Capacity at Landon Branch Lift Station

The Landon Branch Lift Station was constructed in 1969; therefore, the wet well and cast iron pipe force main are 46 years old.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

Project 14, as proposed herein, will replace and add pumping capacity to the Landon Branch Lift Station. This project should be constructed only after Projects 4 and 7 (Brazos Basin Interceptor) are completed. The Landon Branch Lift Station was originally constructed in 1969 and was partially rehabilitated in 1988. Therefore, both the wet well and 14-inch cast iron pipe force main are 46 years old. The control and some of the electrical components appear to be the original 1969 vintage equipment. City staff indicated that they don't experience major problems with this station. Their largest concern is that the site has 240V power with 75 HP motors. **The reported firm pumping capacity is 2,300 gpm making it the second largest lift station in the collection system.** The existing lift station is a triplex dry pit station**. It is recommended that the proposed lift station consist of a submersible triplex pump station with a firm pump capacity to handle peak wet weather flow (PWWF) with the largest pump out of service.** Water Utilities staff considers the existing wet well to be undersized. During the Team's lift station evaluation, it was observed that the existing wet well is too small to install submersible pumps and convert the existing station from a dry pit station to a submersible station; therefore, the wet well structure will require replacement. Observations from the lift station evaluation also indicated that the existing wet well walls exhibit exposed aggregate, heavy corrosion, and cracks near the water surface. No coating materials were present to protect the structure from hydrogen sulfide attack.

The firm pumping capacity should be further evaluated prior to the initiation of Project 25 (see Section 8.3.25), whereby flows from Greenleaf, Village Green, Park Lake, and Chimney Hills Lift Stations are to be rerouted away from the Bosque Lift Station, Carver Lift Station (WMARSS), and LaSalle Lift Station (WMARSS) (thereby freeing up capacity within the East Bank Interceptor) and routing the associated flows towards the Landon Branch Lift Station via the new Brazos Basin Interceptor to the Transfer Lift Station (WMARSS). **Re-routing flows away from the WMARSS East Bank Interceptor will free up available future capacity to allow for future growth in the Village Lake and Carver Basins.**

The additional pumping capacity needs to be evaluated before deciding to reroute the Park Lake Lift Station flows towards the Landon Branch Lift Station and away from the Bosque, Carver, and LaSalle Lift Stations.

The construction of this project will give the City a long-term solution to provide more effective system conveyance capacity within portions of the Barron's Branch and Bosque River Wastewater Basins. Project 14 is recommended for implementation in the year 2020. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 14 is $1,559,300.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.15. Project 15: Added Capacity TSTC Lift Station and Force Main Improvements

Water Utilities staff has conveyed that the existing TSTC force main is in very poor structural condition.

Project 15, as proposed herein, will provide additional pumping capacity as well as replace significant portions of the existing force main that is in very poor structural condition. The TSTC Lift Station was constructed in 1991. Water Utilities staff has indicated that the station is in fair condition and that the force main is in very poor condition. The existing firm pumping capacity of the duplex station is reported to be 500 gpm. A number of years ago, the City added a third pump. The station essentially pumps the same flow volume regardless if one, two, or all three pumps are running. At the conclusion of this project, the associated TSTC Lift Station flows will be routed away from the existing WMARSS Bellmead Interceptor, thereby allowing the Bellmead Interceptor to recover needed available capacity (especially for the Baylor Research & Innovation Collaborative area). **The construction of this project will give the City a long-term solution to provide more effective conveyance capacity within the portion of the MLK Wastewater Basin serving the TSTC area.**

Water Utilities staff conveyed that sanitary sewer overflows regularly occur upstream of the COW TSTC Lift Station. Texas State Technical College owns and operates a lift station located upstream of the COW TSTC Lift Station that has a greater pumping capacity than the City's downstream lift station. **This may explain the number of overflows that Water Utilities staff has historically reported along the gravity section upstream of the COW TSTC Lift Station.** It is understood that the upstream collection systems (both the TSTC collection system and City of Waco collection system) are inundated by inflow & infiltration during wet weather events causing overflows to occur upstream of the COW TSTC Lift Station site. **The TSTC Waco campus currently boasts over 5,000 students. The campus site was formerly the James Connally Air Force Base. It is believed that a majority of the accompanying wastewater collection system was originally installed either in the late 1940's or early 1950's. The circa 65 year old wastewater system is known to be failing.**

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

The City engaged in an engineering contract in 2013 to identify (and design) short-term measures that would address the existing force main that is in very poor structural condition. Water Utilities staff expressed great uneasiness regarding the structural condition of the existing troublesome force main. Staff additionally indicated that they prefer that the force main be relocated away from US 84 (along existing alignment) near Loop 340 due to the number of businesses that are currently located in this area. Lockwood, Andrews & Newnam developed a Technical Memorandum dated December 13, 2013 which described three alignment options. It is understood that a final decision as to how to proceed as part of the aforementioned effort is still under consideration.

Walker Partners submitted a Technical Memorandum to WMARSS in 2014 that provided a recommended scope of a project that would benefit Waco, Bellmead and WMARSS.

On March 20, 2014 Walker Partners submitted a Technical Memorandum to WMARSS entitled *Cities of Bellmead and Waco/WMARSS Joint Wastewater Feasibility Study*. **This memorandum provides extensive additional information on institutional knowledge and prior coordination that occurred between the WMARSS, Waco, and Bellmead and the final recommended scope of a project that would benefit all three entities from both a short-term and long-term perspective.** It is envisioned that the force main coming from the TSTC station should eventually tie into Capital Improvement Program Project 8. The proposed project would eliminate a large portion of the troublesome force main and reroute flows away from the WMARSS Bellmead interceptor which is hydraulically insufficient during wet weather events. The Cities of Waco and Bellmead as well as WMARSS are currently evaluating this option along with the 2013 contract engagement to arrive at a final solution which will alleviate the recurring problems within this portion of the collection system.

A review of the TSTC Lift Station record drawings indicates that the station was designed for two conditions (both an "initial condition" and a "future condition"). **When the wastewater flows warrant the "future condition" (i.e. requiring a 16-inch force main in lieu of the current 8-inch force main), the existing station can be converted from a duplex pump operation to a tri-plex pump operation.** At that time, the station will be able to pump a maximum flow of up to 2,778 gpm. This "future condition" pumping capacity is approximately 5.5 times the capacity that the "initial condition" currently provides. Therefore, it is expected that as part of the project, the lift station itself will only require pumps to be replaced. The existing wet well appears to be adequately sized and will not require any modifications. **A larger diameter force main will allow the existing pumps to be replaced in the current station with pumps that will be able to accommodate peak wet weather flows with the largest pump out of service.** The peak wet weather flow is currently estimated to be greater than 950 gpm.

It is very important that the City fully understand that both the Waco and WMARSS downstream collection systems require additional hydraulic capacity before the lift station's pumping capacity can be increased.

It is very important that the City fully understand that both the Waco and WMARSS downstream collection systems require additional capacity before the lift station's pumping hydraulic capacity can be increased. Therefore, this project should be constructed only after Project 8 (WMARSS Project 2 – Lacy Lakeview / Bellmead / TSTC Interceptor) is completed.

Figure 8-30: Project 15: 5-year, 6-hour model results – Before Project

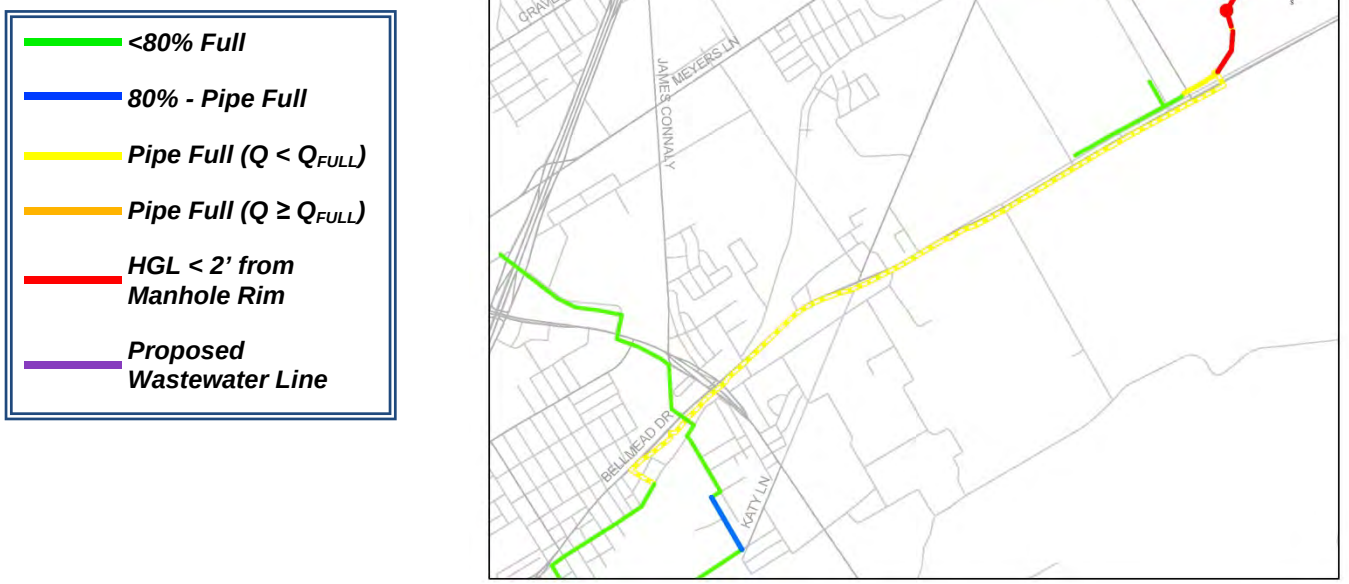
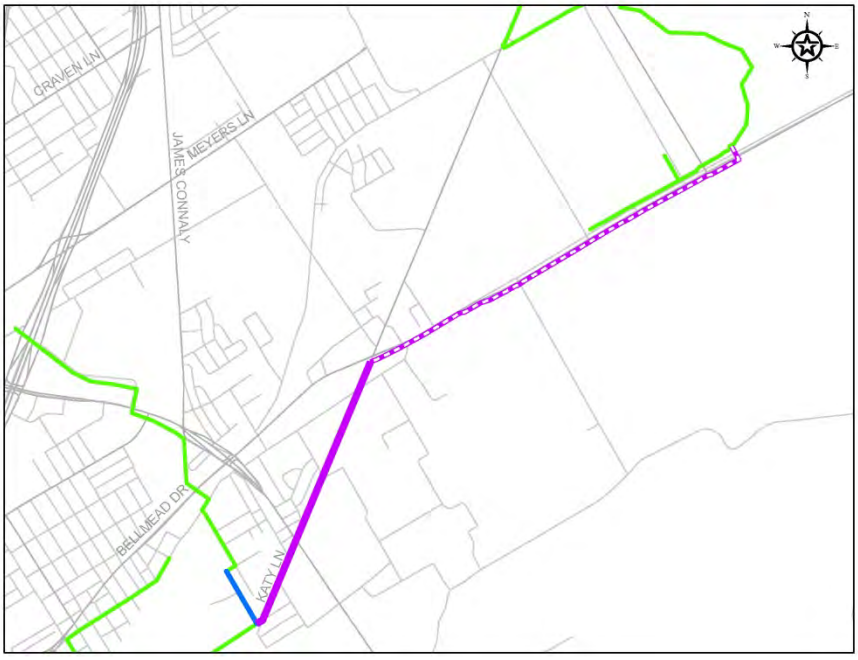


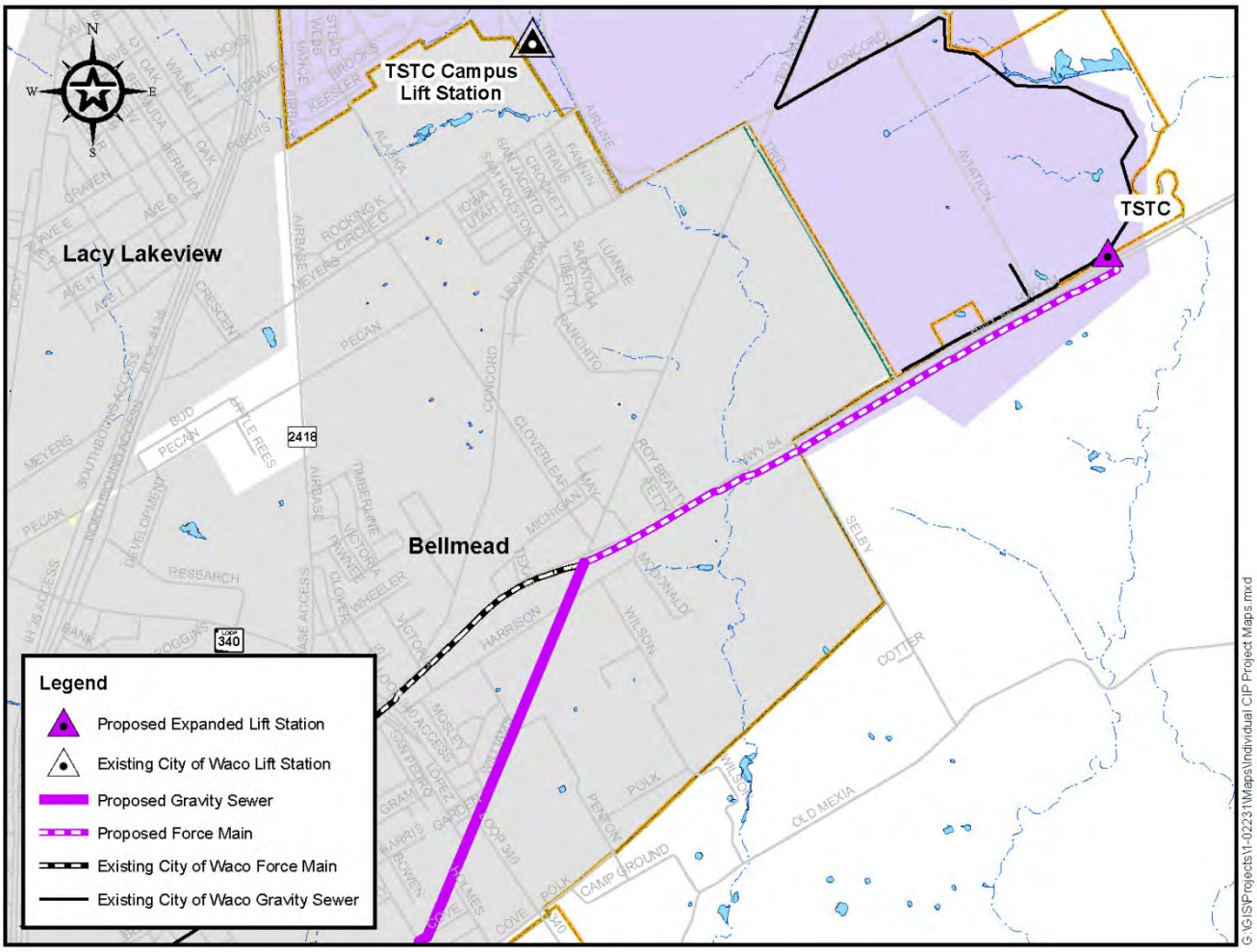
Figure 8-31: Project 15: 5-year, 6-hour model results – After Project



Project 15 (Figure 8-32) is recommended for implementation in the year 2021. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 15 is $6,463,525.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total

estimated project cost.

Figure 8-32: Project 15: Added Capacity TSTC Lift Station and Force Main Improvements



8.3.16. Project 16: Abandon Existing Lindsey Hollow Lift Station and Gravity Extension

The Lindsey Hollow Lift Station is the 5th largest lift station within the City's current collection system. The project would eliminate one large station and possibly several smaller stations from the City's wastewater collection system.

Project 16, as proposed herein, will allow for the abandonment of the Lindsey Hollow Lift station by converting from force main to gravity sewer. The final route alignment would likely require trenchless methods under areas that are highly wooded. The final profile alignment may allow for the removal of a number of aerial crossings that currently exist within the Barron's Branch Basin collection system. The Lindsey Hollow Lift Station was constructed in 1979 making it approximately 35 years old. Based upon its age, it is generally inferred that the existing lift station is nearing the end of its estimated life expectancy. **The Lindsey Hollow location currently has the fifth largest pumping capacity of the lift stations within the City's system.** Due to the capacity of the station, a failure at this station would have a large impact on the City.

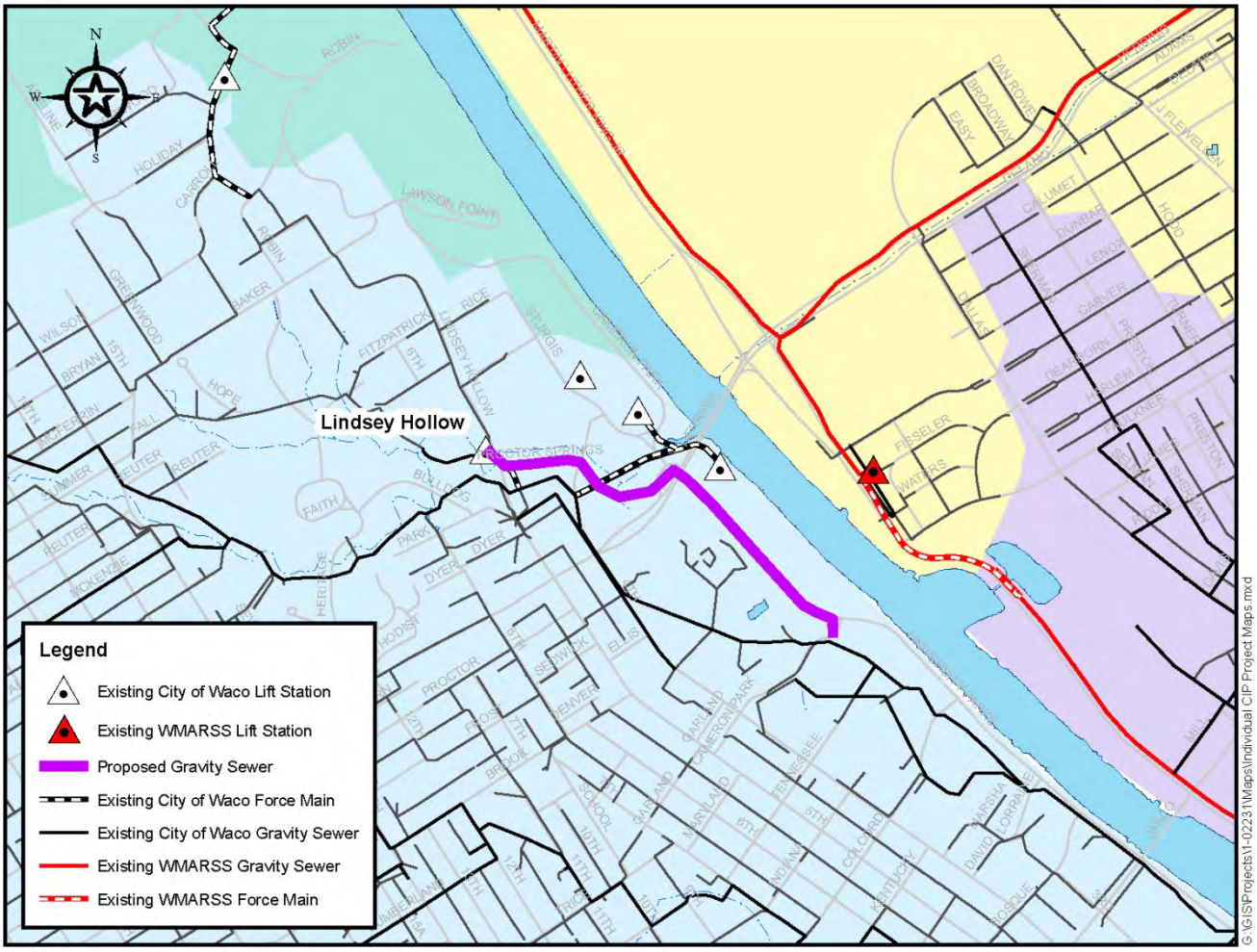
3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

Water Utilities staff provided a good rating for condition and capacity based upon the age of the existing station. Historically, significant fats, oil and grease have been problematic upstream of the station causing the incoming gravity sewers to stop up on a recurring basis. These existing gravity sewers are also considered to be in very poor structural condition. Within the last couple of years, this problem has seemed to lessen. Additionally, the City bid a construction project in the last couple of years that replaced several manholes within the Methodist Home area.

The proposed outfall will likely be located near the intersection at Herring Avenue and Cameron Park Drive. **Based upon the preliminary routing and during design, the City should also evaluate abandoning the Cameron Park Lift Station, Redwood Shelter Lift Station, and Pecan Bottoms Lift Station.** Each of these lift stations ultimately route their flows to the West Bank Interceptor. This project should be constructed only after Project 8 (Brazos Basin Interceptor) is completed. It is recognized that this project would be costly. As mentioned previously, the Lindsey Hollow Lift Station is the 5th largest lift station within the City's current collection system and the project would eliminate one large station and possibly several smaller stations from the City's wastewater collection system. The abandonment would also eliminate any future City operation, electrical and maintenance costs associated with maintaining lift stations.

Project 16 (Figure 8-33) is recommended for implementation in the year 2021. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 16 is $2,817,750.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-33: Project 16: Abandon Lindsey Hollow Lift Station and Gravity Extension



8.3.17. Project 17: Barron's Branch – Added Capacity Line from 12th Street/Barron's to West Bank Interceptor

Numerous sections within the Barron's Branch Basin have been identified as being severely overloaded during wet weather events.

Project 17, as proposed herein, will provide hydraulic capacity to an area that is currently deficient as well as replace a number of segments that are considered to be structurally deficient. This project was essentially identified as a 2003 to 2008 System Improvement Project in the ***2005 Hydraulic Modeling of Major Collection Lines Serving the East and West Bank Outfalls Report***.

A number of the wastewater studies performed in the early to mid-1990's as well as the 2006 study concluded that numerous sections of the wastewater system within the Barron's Branch Basin were severely overloaded during wet weather events. As these pipes and manholes have continued to age over the last 25 years, it is reasonable to assume that the wet weather capacities have continued to deteriorate over time.

This project is not recommended to be initiated until after the proposed Brazos Basin Interceptor Projects are completed due to the fact that currently the West Bank Interceptor is hydraulically deficient during wet weather events. The Team also recommends that this project not be initiated until after Project 12 (Rehabilitation of portions of West Bank Interceptor) is completed.

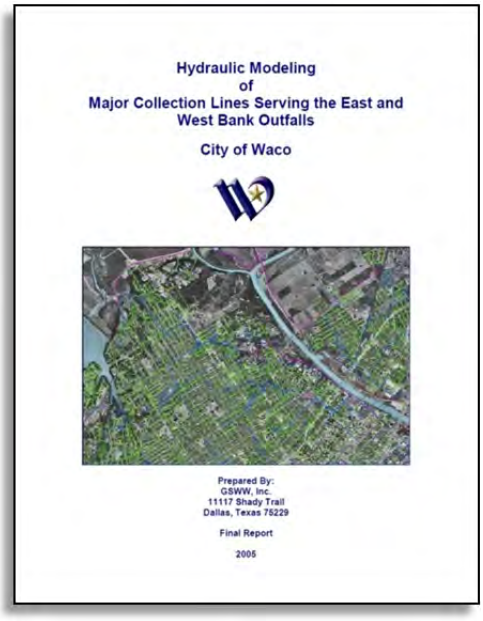
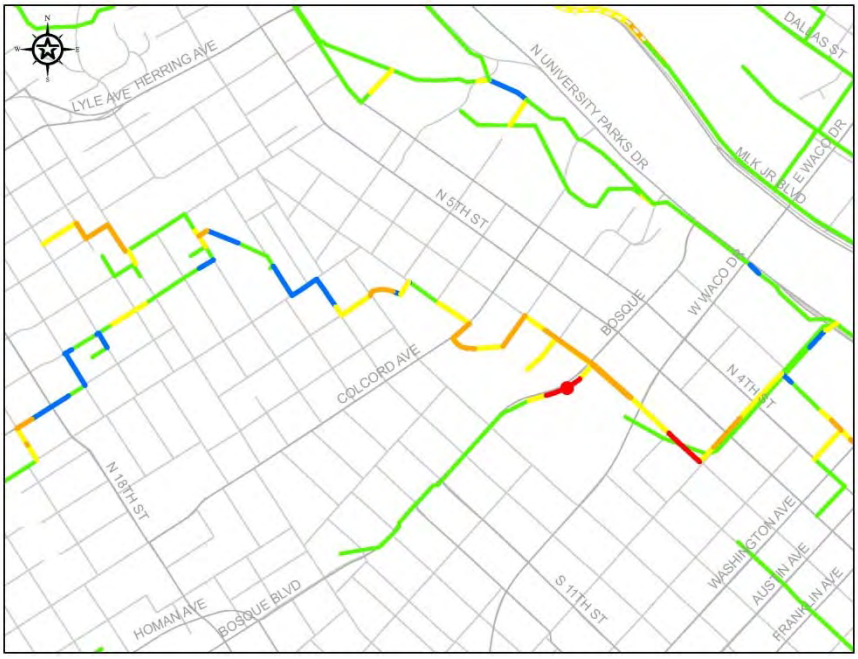
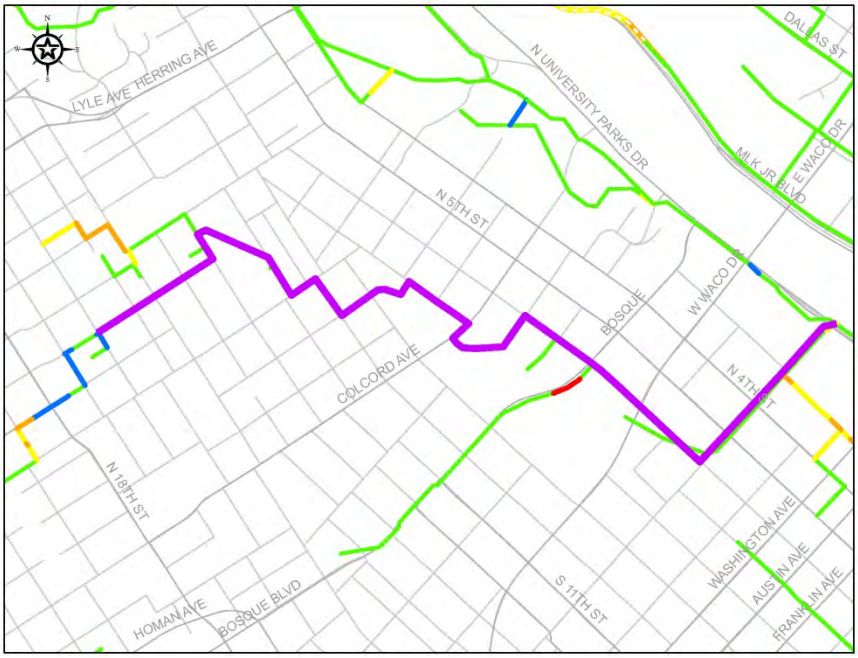


Figure 8-34: Project 17: 5-year, 6-hour model results – Before Project



- *<80% Full*
- *80% - Pipe Full*
- *Pipe Full ($Q < Q_{FULL}$)*
- *Pipe Full ($Q \geq Q_{FULL}$)*
- *HGL < 2' from Manhole Rim*
- *Proposed Wastewater Line*

Figure 8-35: Project 17: 5-year, 6-hour model results – After Project



The Brazos Alluvium and ground water table will need to be considered during design and construction due to the fact that the line is located upstream of the Lake Brazos Dam. **There are approximately 9 aerial crossings along the alignment of the existing wastewater line. During design, consideration to remove as many of these aerial crossing sites as practical should be a priority.**

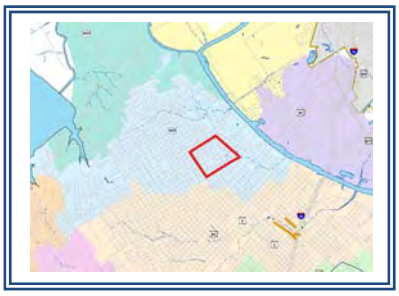
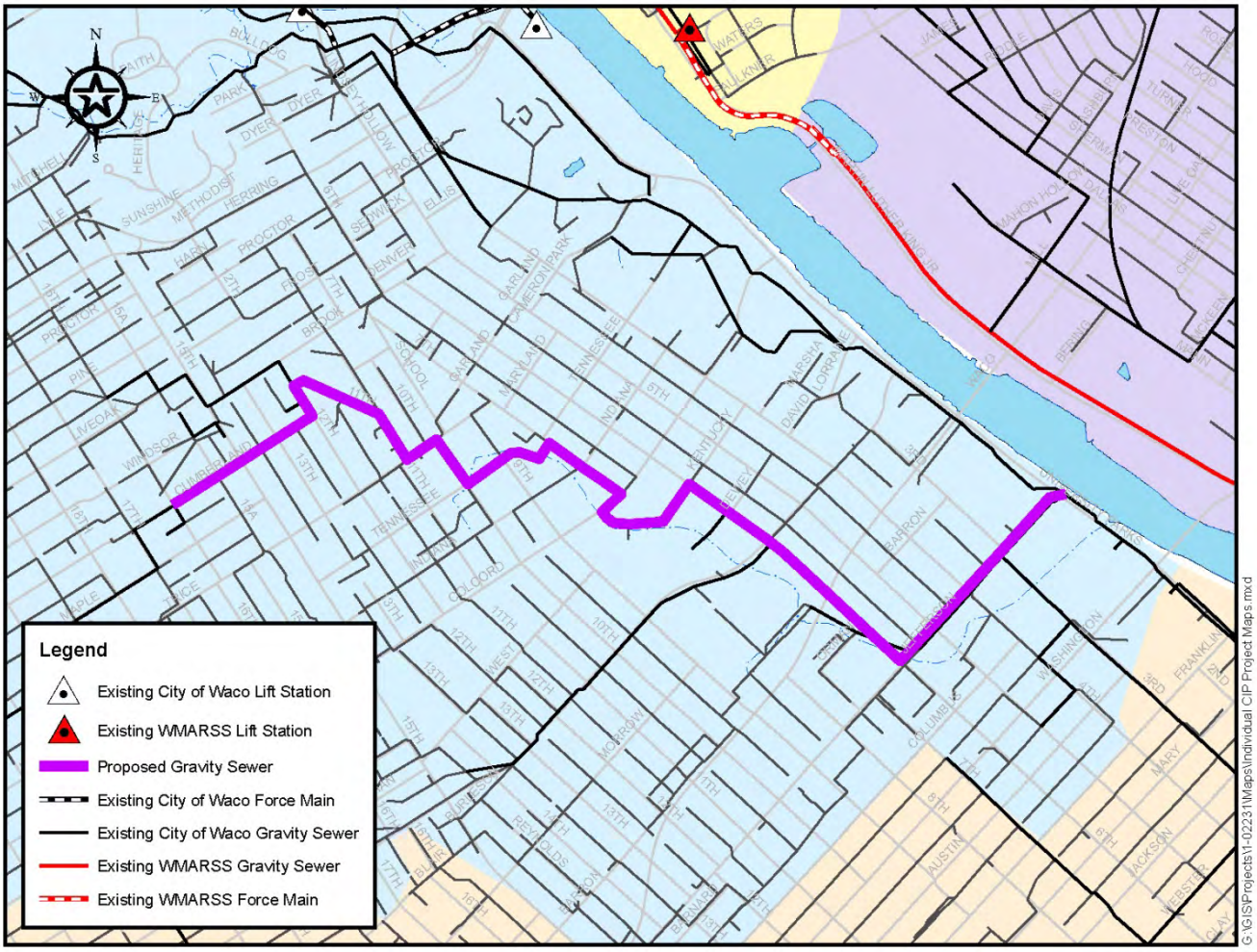


Figure 2-20: Barron's Branch Basin Asset Renewal Area (Red): Identified by Water Utilities staff (Page 2-51)

During the historical / institutional knowledge investigation, Water Utilities personnel identified **a portion of the Barron's Branch drainage basin bounded by 18th Street on the west, Live Oak Avenue on the north, 8th Street on the east, and Colcord Avenue on the south as a source of multiple and varied collection system problems.** This area was shown in Figure 2-20 (Page 2-51). The supposition by staff is that because the general area is very flat, the wastewater system experiences low flow velocities and deposition of solids which create maintenance challenges. A significant percentage of the existing gravity sewers in this area run in backyards and under structures.

It is recommended that this project should be constructed within the next 10 years to eliminate the existing rainfall driven SSO's. Project 17 (Figure 8-36) is recommended for implementation in the year 2022. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 17 is $4,277,825.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

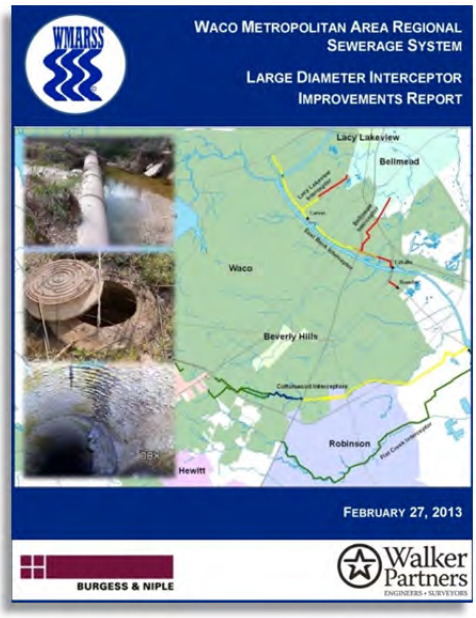
Figure 8-36: Project 17: Barron's Branch – Added Capacity Line from 12th Street/Barron's to West Bank Interceptor



THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.18. Project 18: WMARSS Project No. 4 – Replace Lower Limits of Cottonwood Interceptors

Project 18, as identified within the February 2013 WMARSS Large Diameter Interceptor Improvements Report, will include the construction of open cut replacement of a portion of the Cottonwood Interceptors from 12th Street to the Main Lift Station at the Central Plant that are currently in very poor structural condition. **While investigations have concluded that the 1989 interceptor is in slightly better structural condition than the original 1970 line, field inspections have confirmed that both lines exhibit significant structural degradation and are in danger of failure.** This is corroborated by the fact that a segment within the proposed project limits failed within the last five years and required emergency repairs. Additionally, the 1989 line is generally laid at a higher elevation than the original 1970 line and the 1989 line is exposed (and compromised) at a number of points where the wastewater line crosses Cottonwood Creek. Therefore, it is recommended that both of the existing Cottonwood Interceptors be replaced with a single pipeline of sufficient capacity and depth. It is expected that during construction that the flows can be routed temporarily into one of the gravity interceptors allowing for the construction of the new line to be primarily placed in the existing easement. This would minimize the additional easement requirements. After construction, the existing Cottonwood Interceptors would be abandoned in place.



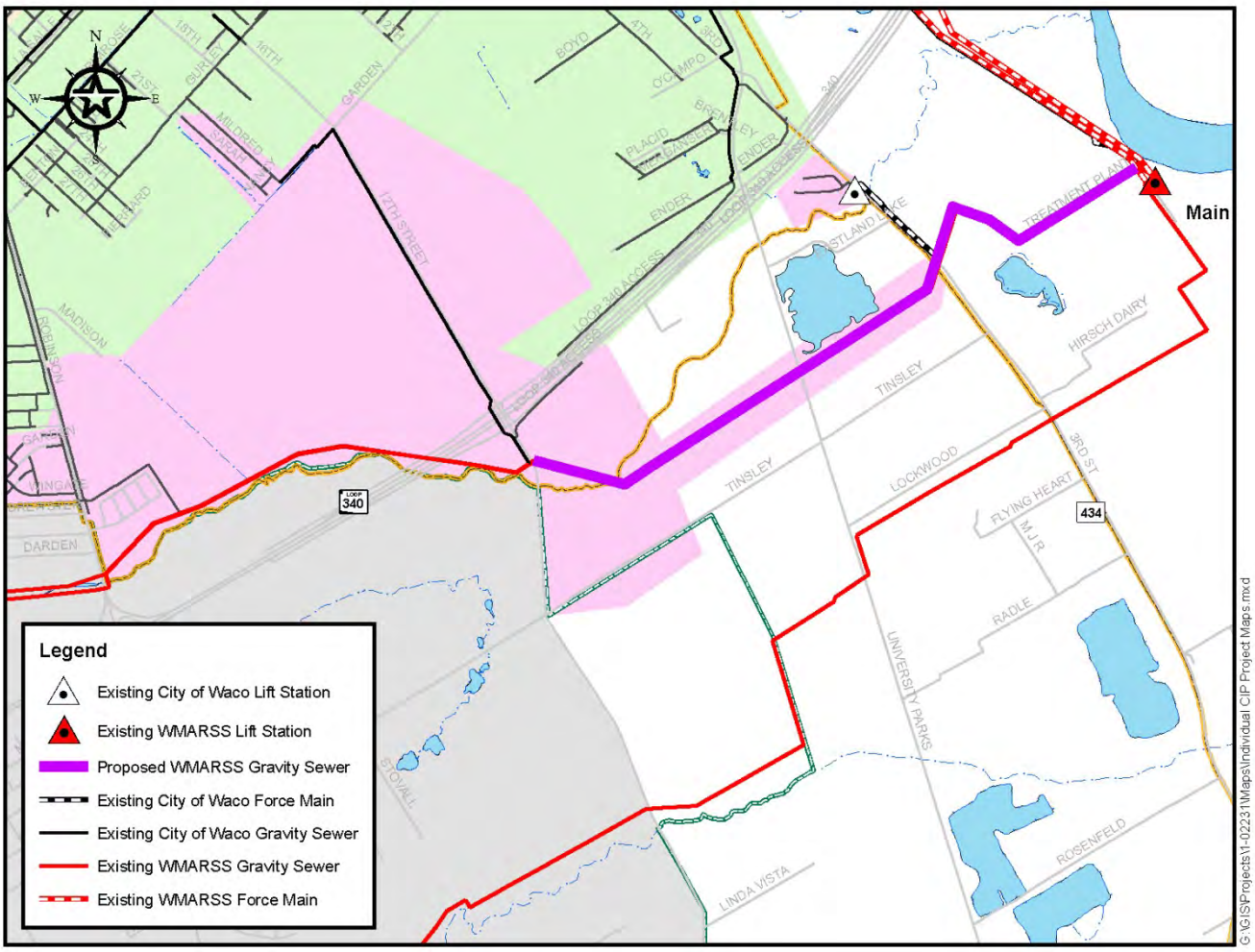
Immediate wet weather flow holding facilities and pumping capacity improvements are required at the WMARSS Central Wastewater Treatment Plant. The associated wet weather flow holding upgrades are additionally discussed in Section 8.3.1.

Within the last five years, WMARSS has experienced the failure of a segment of pipe within the proposed project limits that has required emergency repair. Additionally, the line is exposed at a number of points where the wastewater line crosses Cottonwood Creek.

The 2013 WMARSS Large Diameter Interceptor Improvements Report identified an immediate needs project that would assist in addressing the inadequate pumping capacity that currently exists at the WMARSS Main Lift Station. The Main Lift Station improvements need to be addressed either prior to or as part of Project 18. Wet weather flow holding facilities and pumping capacity improvements are discussed in detail in Section 8.3.1. During the WMARSS Large Diameter effort, WMARSS staff communicated that a 10 MGD Main Lift Station firm pumping capacity improvement project was funded within their current WMARSS Operations and Maintenance budget. WMARSS staff additionally conveyed that the existing peak wet weather basin would be large enough to handle the additional 10 MGD Main Lift Station capacity. Since this is considered a prior funded WMARSS upgrade, the costs associated with the increased pumping capacity are not specifically included within the Capital Improvement Program project cost. WMARSS current status regarding this effort is unknown. If the Main Lift Station improvements have not been initiated, the Team recommends that the design and construction of these improvements should begin as soon as possible.

Project 18 (Figure 8-37) is recommended for implementation in the year 2022. Easement acquisition is anticipated for the identified improvements. The WMARSS Large Diameter Interceptor Improvements Report included an estimated project cost for Project 18 of $7,546,000.00. The City of Waco participation amount (currently @ 75.3%) is $5,683,000.00.

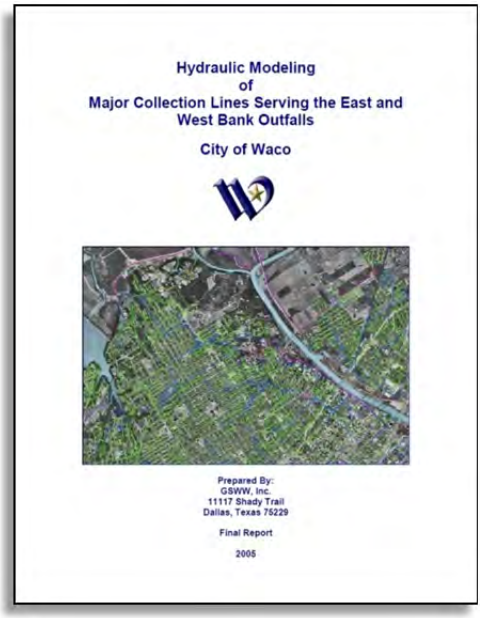
Figure 8-37: Project 18: WMARSS Project No. 4 – Replace Lower Limits of Cottonwood Interceptors



8.3.19. Project 19: Cottonwood Basin Added Capacity Wastewater Line

A major portion of the main trunk line runs parallel to Upper Waco Creek. The local high wet weather peaking factors indicate that extraneous flow is allowed into the adjacent lines that inundate the system during rain events.

Project 19, as proposed herein, **will provide additional hydraulic capacity to a portion of the Cottonwood Basin area that is currently hydraulically limited as well as believed to be in poor to very poor structural condition.** The proposed limits begin at Hiland Drive and extend westward to Bosque Boulevard. Significant portions of this approximate 7,000 linear foot line were originally constructed in the mid-1950's with vitrified clay tile pipe and concrete pipe materials. The existing line segments are approaching 60 years in age. A major portion of the main trunk line runs parallel to Upper Waco Creek. **Water Utilities staff has indicated that there may be an existing siphon east of Wells Fargo Bank that may contribute to some of the problems in the area.** A portion of the line (in the vicinity of Academy Sports) was replaced (relocated) in the early 1990's and is in acceptable structural condition. This project should be initiated after Project 13 (Wooded Acres reroute to Brazos Basin) is completed.



This project was identified as a 2003 to 2008 System Improvement Project in the ***2005 Hydraulic Modeling of Major Collection Lines Serving the East and West Bank Outfalls Report***. It is recommended that this project be constructed within the next 10 years to eliminate the existing rainfall event SSO's.

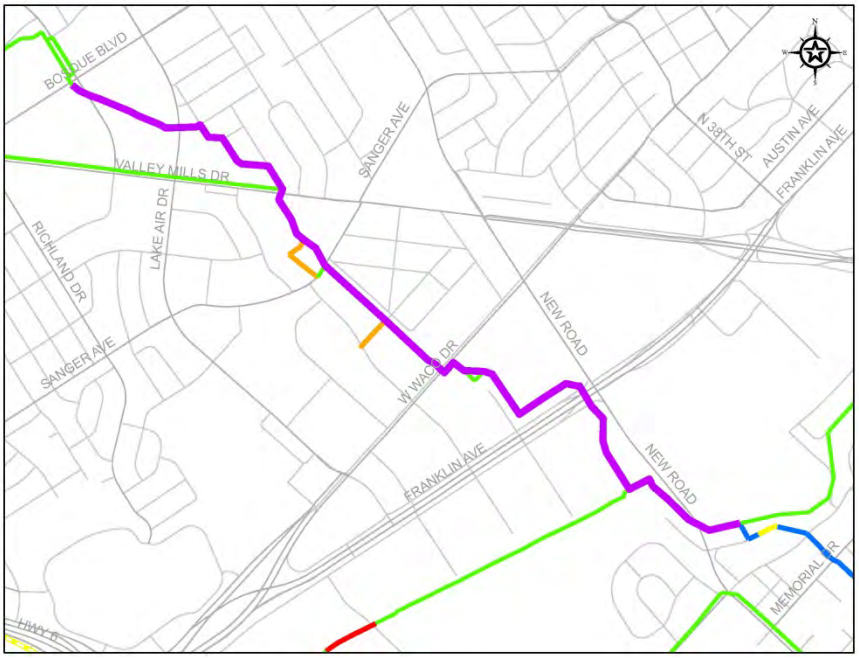
There are five aerial crossings along the alignment of the existing wastewater line that it will be important to endeavor to remove these aerial crossing sites during the design phase. In the City identified Asset Renewal Project No. 1, segments CW-3 & CW-5 (see Chapter 2, Section 2.4) have been identified within the same limits of this project. City staff will need to ensure adequate coordination prior to initiating these projects.

Based upon the size of the upstream collection system, it wouldn't be expected that there would be a significant capacity issue with this line above Valley Mills Drive. **A Sanitary Sewer Assessment should be undertaken in this area to attempt to identify extraneous inflow currently entering into the system.** The closest flow meters that were installed during the temporary monitoring period were TB02, CW07, and CW08. The TB02 meter showed a peaking factor of 9.5, the CW07 metered showed a peaking factor of 7.0, and the CW08 meter showed a peaking factor of 5.5. Therefore, each monitor indicated a wet weather peaking factor that would indicate that extraneous flow is allowed into the adjacent lines that would subsequently inundate the system. **It is recommended that Water Utilities closed circuit television personnel inspect the line that runs along the creek to determine if defects are present along the line.** These unidentified inflow and infiltration sources could be caused by a wide variety of items including root intrusion into the lines, defective pipe joints, cracked lines and manholes, displaced manholes, missing manhole covers, and missing service cleanouts. Each of the above referenced items allows rainfall runoff to enter the

sanitary sewers during wet weather events.

Figure 8-38: Project 19: 5-year, 6-hour model results – Before Project

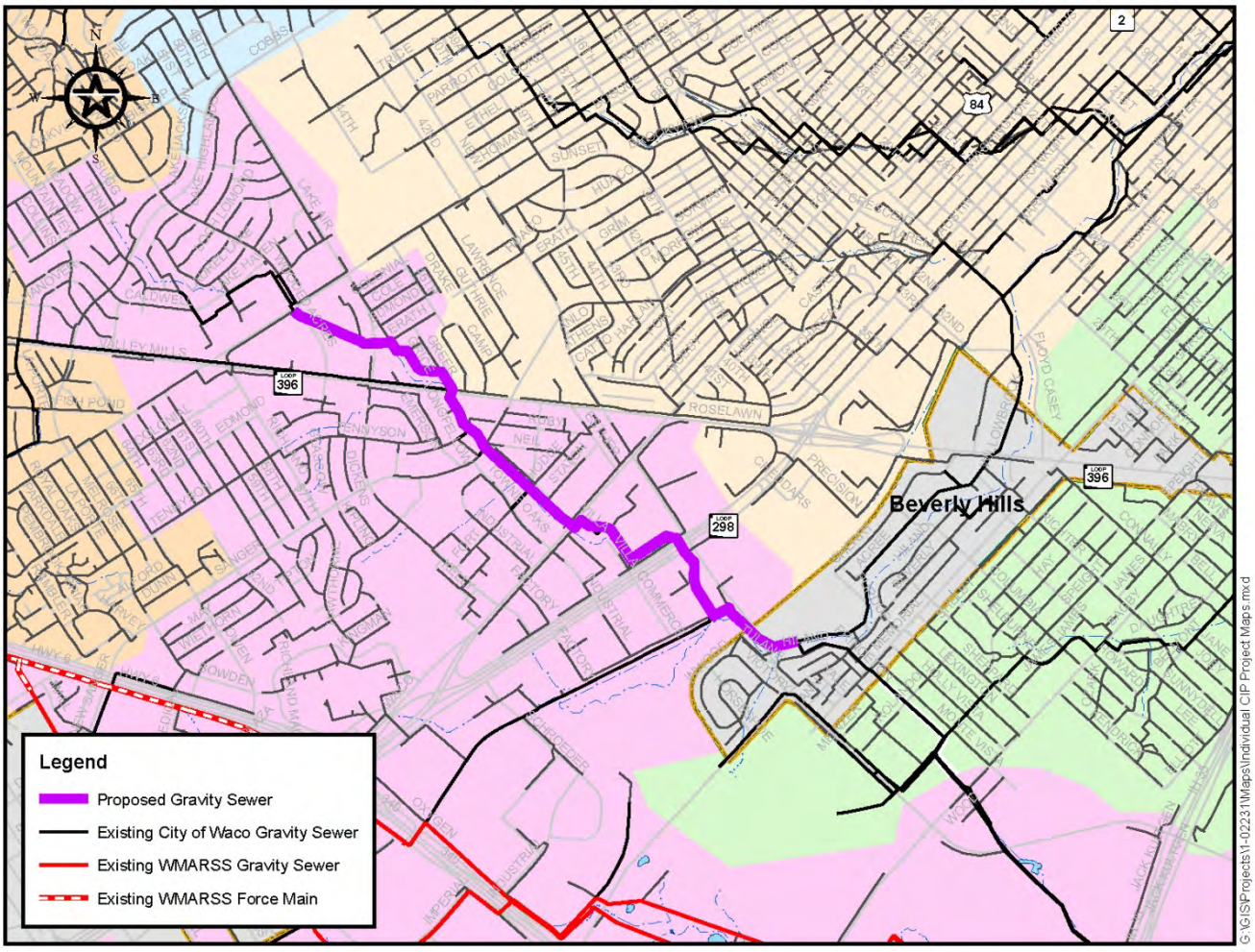
Figure 8-39: Project 19: 5-year, 6-hour model results – After Project



Project 19 (Figure 8-40) is recommended for implementation in the year 2022. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 19 is

$8,272,400.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-40: Project 19: Cottonwood Basin Added Capacity Wastewater Line

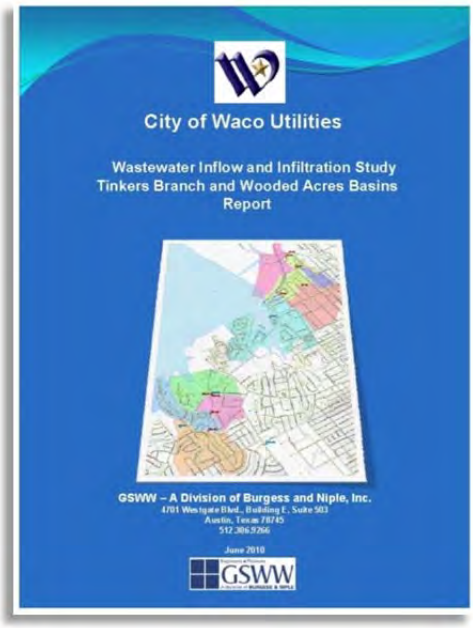


THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.20. Project 20: 2023-2026 Asset Renewal Project No. 3 – Replace / Rehabilitate structurally deficient existing small diameter lines

This project will provide for the replacement of approximately 140,000 linear feet of existing pipe that is currently in very poor structural condition and in need of replacement.

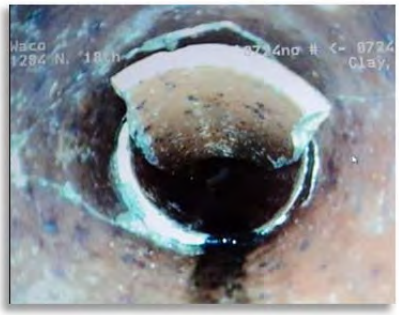
Project 20, as proposed herein, will provide for the replacement of approximately 140,000 linear feet (or roughly 4.0% of the total length of the collection system) of existing pipe (primarily vitrified clay tile lines) that is currently in very poor structural condition and in need of replacement. **By responsibly rehabilitating and/or replacing structurally deficient small diameter collection lines, the City will preserve existing system hydraulic capacity for future growth as well as reducing the City's cost of paying for excessive wet weather treatment and transportation.**



Tinker's Branch and Wooded Acres Basins Wastewater Inflow and Infiltration Study

The lines to be identified should be selected based upon Sanitary Sewer Assessments, temporary flow monitoring prioritization, work orders, closed circuit television inspection of lines and/or historical and institutional knowledge. The City should additionally utilize the Tinkers Branch and Wooded Acres Basins Wastewater Inflow and Infiltration Study Report (previously discussed in Chapter 2) as well as reference Chapter 7, Section 7.1. Future Sanitary Sewer Assessments (SSA's) to assist in the final selection of deficient locations. SSA's greatly assist in pinpointing structurally deficient lines as well as identifying inflow and infiltration locations to reduce the excessive peak wet weather flows within both the older portions of the City's collection system and the WMARSS collection system. Based upon availability, City staff may choose to perform a portion of the required CCTV services in-house in order to assist in controlling costs.

Section 8.3.10 (Project 10) discusses various lift stations that should be evaluated for consideration as an asset renewal project. The City should decide to include other "small" lift stations for rehabilitation or replacement as they are determined to require attention. **As these stations continue to age, they will require attention in order for the City to maintain or improve the systems current operating benchmark.**



Clay tile fragment in line attributable to upstream pipe collapse.

Project 20 is recommended for implementation in the year 2023. The limits of the Project 20 improvements will not be identified until further investigations are completed. Easement acquisition will be anticipated for many of the identified asset renewal improvements. The total estimated project cost for Project 20 is $35,000,000.00. There is no associated project map since the target segments have not yet been established.

THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.21. Project 21: Abandon McLennan County Jail Lift Station and Gravity Extension to WMARSS LaSalle Lift Station

Lift Stations located downstream of jails are always maintenance problems.

Project 21, as proposed herein, will abandon and remove the McLennan County Jail Lift Station by installing approximately 3,725 linear feet of 15-inch diameter gravity sewer. **The proposed line will be constructed along and adjacent to Marlin Highway from the existing McLennan County Jail Lift Station and to the newly located WMARSS LaSalle Lift Station.** The project would allow for the decrease of one lift station within the collection system. The project would additionally eliminate the requirement for any future City operation, electrical, and maintenance costs associated with the continuous operation of the existing lift station.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

Project 2 (WMARSS Project No. 1 – LaSalle Lift Station Relocation & Force Main Extension to Central Plant) is a required predecessor project to this project. **Without the relocation of the LaSalle Lift Station below the Lake Brazos Dam, the McLennan County Jail Lift Station / force main abandonment and gravity extension project cannot not be accomplished.** Currently, the McLennan County Jail Lift Station pumps to the existing WMARSS LaSalle Lift Station, which subsequently pumps to the WMARSS Transfer Lift Station and finally to the WMARSS Central Plant. At the conclusion of Projects 2 and 7, the McLennan County Jail flows will flow by gravity to the proposed WMARSS LaSalle Lift Station and pump directly to the WMARSS Central Plant (rerouted away from the Transfer Lift Station).

Water Utilities staff rated the station very poor for both structural condition and hydraulic capacity even though the station is only approximately 7 years old.

It is understood that the McLennan County Jail Lift Station was designed in 2004 to serve approximately 800 beds. The project was constructed in 2007. In 2009, the jail expanded adding an additional 800 beds. At the time of the expansion, neither the lift station capacity nor the force main size were modified. Since the time of the expansion, **Water Utilities staff has indicated that the existing pumps run almost constantly during dry weather flow.** Water Utilities staff rated the station very poor for both structural condition and hydraulic capacity even though the station is only approximately seven years old. The existing pumps are undersized for the current influent loading concentrations. The current jail loading (peak flow) is estimated to be 1.5-1.8 times the current pumping capacity. In the short term, it is recommended that the City investigate the option of replacing the existing pumps at the lift station with larger pumps. Due to the size (4-inch) of the existing force main, that station will only be able to support a small firm pumping increase (in the range from 125 gpm to 225 gpm). **The desired long-term solution is to abandon the lift station at the existing location and change over to a gravity system.**

Water Utilities staff has conveyed that “plugging” is a problem with the existing pumps at the lift station. The flow from the jail is not “standard wastewater” in that it contains unusual quantities of size and gross

solids. Therefore, the existing pumps have historically had trouble handling wastewater from the prison facility. **The existing in-line screw auger waste removal system that was installed in 2009 does not adequately ground / screen / handle the solids within the waste stream.** It's recommended that the City of Waco and McLennan County come together to discuss this matter. Several possible options for adequately handling the current plugging problem include:

1) Replacing the existing County screw auger waste removal system with in line comminutors at the jail that will grind up all the debris coming from the jail.

It is recommended that in line comminutors be installed upstream of the jail lift station in order to adequately grind up all the gross solid loading coming from the jail.

2) Replacing the existing pumps with "Chopper Pumps" which will grind up all the debris coming from the jail before pumping occurs. The "Chopper Pumps" would be much more expensive than standard pumps and would likely require modification of the lift station, where use of standard pumps that fit the existing rails would not.

3) Installing a comminutor at the proposed LaSalle Lift Station Site prior to the waste stream entering the LaSalle wet well.

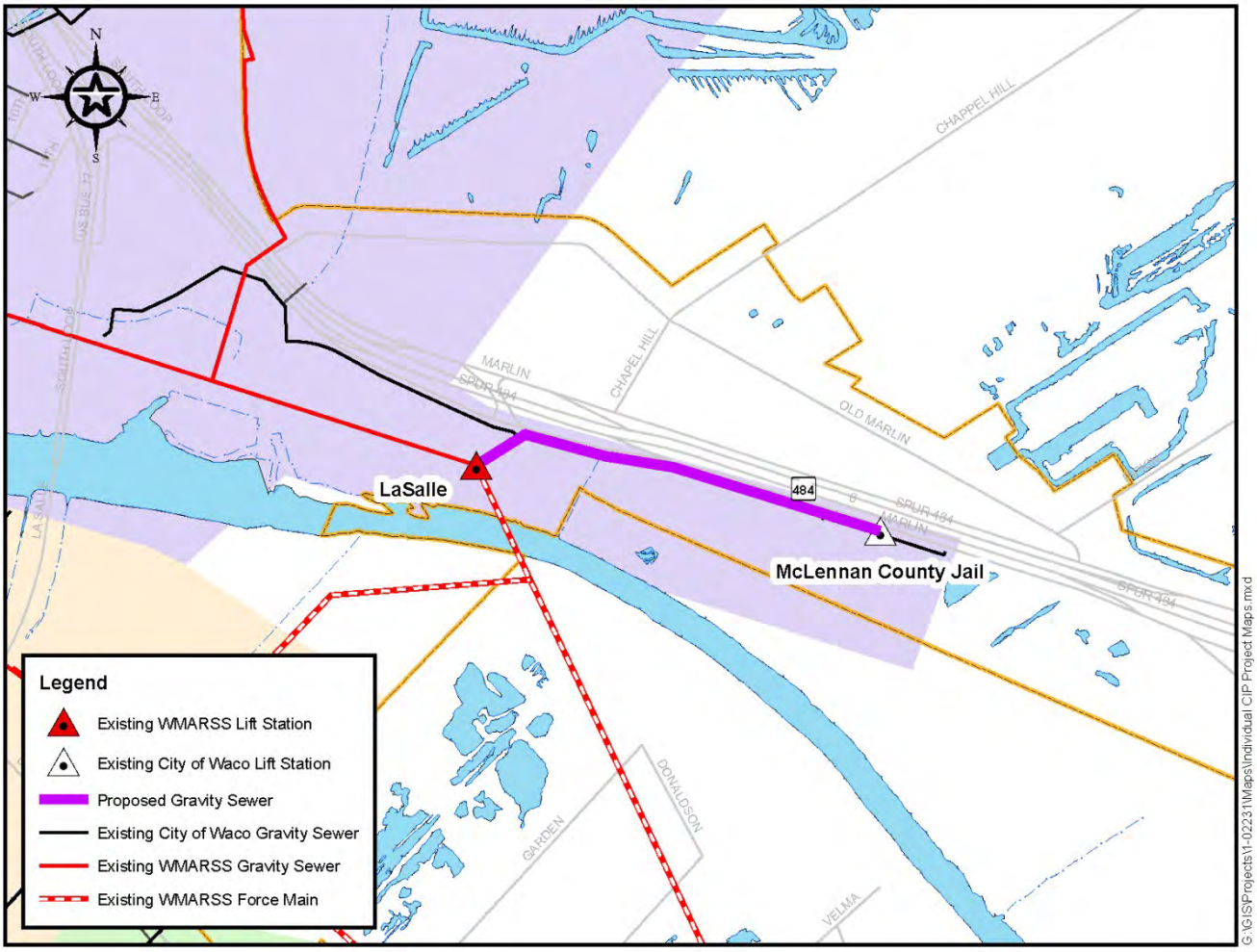
The first option is generally preferred since the comminutor would also protect the future gravity sewer and future LaSalle Lift Station. The upstream and downstream limits of this project are located within the Brazos Alluvium (downstream of Lake Brazos Dam). As has been discussed as part of the project scope of several previous projects, the adverse influences of the Brazos Alluvium must be carefully considered during the proposed design and construction of a new line in the vicinity of the existing force main. The existing groundwater table should be also be analyzed along the proposed route. It is anticipated that the wastewater line will be installed at an approximate 12-foot to 15-foot depth along much of its length. Specifically, the property that is located immediately east of the McLennan County Jail appears to be an abandoned gravel pit or pond. **It is anticipated that significant amounts of groundwater could be encountered during the installation of the pipe.** Adequate dewatering provisions should be taken into consideration during final design.

Currently, a 12-inch gravity line which serves the McLennan County Jail flows into the existing WMARSS LaSalle Lift Station. For the last few years, the City of Waco has been required to operate a temporary bypass pumping system just upstream of the existing WMARSS LaSalle Lift Station due to local ground movement around the existing 12-inch gravity line (believed to be attributed to a nearby Oncor Power Pole installation). Extending the East Bank Gravity Interceptor to the new LaSalle Lift Station location will resolve / remove this current obstruction.

Project 21 (Figure 8-41) is recommended for implementation in the year 2023. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 21 is

$1,187,000.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-41: Project 21: Abandon McLennan County Jail Lift Station and Gravity Extension to WMARSS LaSalle Lift Station



THIS PAGE IS INTENTIONALLY LEFT BLANK

8.3.22. Project 22: Lake Shore Lift Station

The existing Lake Shore Lift Station is approximately 33 years old and should be replaced within the next 10 year period.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

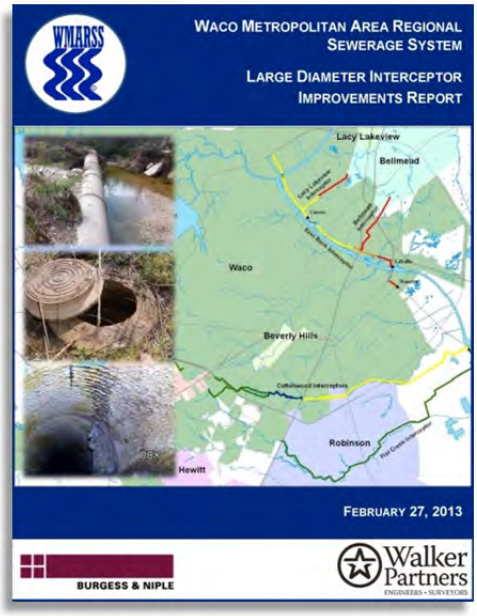
Project 22, as proposed herein, will replace the existing station Lake Shore Lift Station. It is understood that the Lake Shore Lift Station was originally constructed in the early 1980's. As-built drawings were not located for the station. The force main drawings are dated 1982. Therefore, the wet well and associated 10-inch ductile iron pipe force main is 33 years old.

The station's rated pumping capacity is 850 gpm making it one of the five largest lift stations within the City's collection system. Therefore the station would have a very high overall risk rating should it suffer failure. It is understood that the existing pumping capacity is considered adequate for the replacement structure. As part of the lift station assessments phase, it is recommended that this station be replaced within the next 10 year period. City Water Utilities staff has conveyed that they consider the existing station to be in fair condition. It is recommended the upstream collection system (brick manholes) be closely evaluated as part of the final improvements as well as the incoming gravity line that has experienced stop-ups on a frequent basis. Water Utilities staff conveyed that they believe the existing ductile iron force main should be replaced as part of the project; **therefore, the project cost includes the expense associated with replacing the existing 3,760 linear foot ductile iron force main.** It is recommended that City perform visual testing to better identify the condition of the force main to confirm if replacement is warranted at the time the station is replaced. One such option that Water Utilities could consider is to identify two or more locations (either a high maintenance location or location near a high point in the line) where the force main could be dug up and a joint of the existing line be removed in order to provide an indication of the current structural condition. It is understood that the existing ductile iron force main is not lined to protect the pipe in sewer applications.

Project 22 is recommended for implementation in the year 2023. Fee title and easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 22 is $1,764,325.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

THIS PAGE IS INTENTIONALLY LEFT BLANK

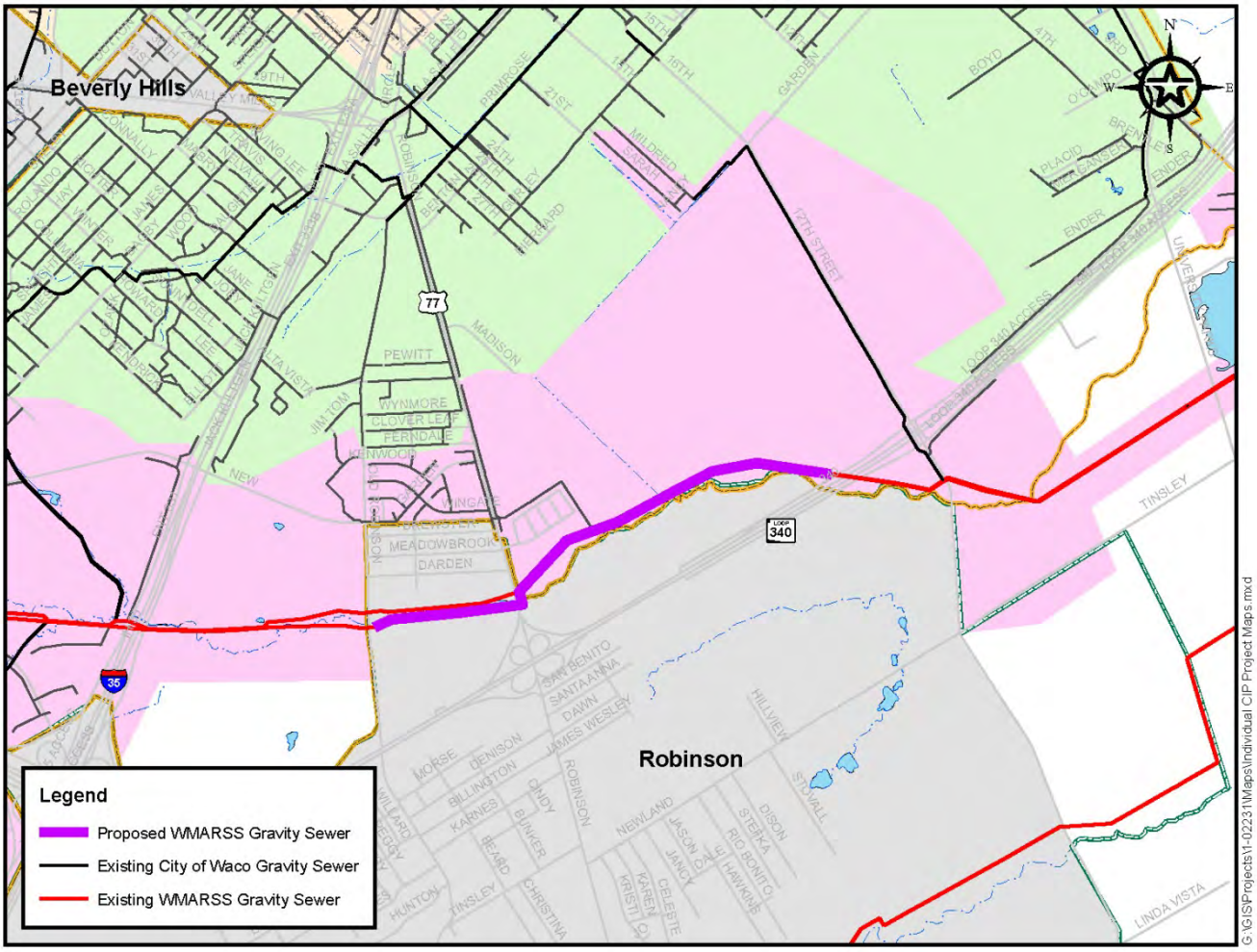
8.3.23. Project 23: WMARSS Project No. 5 – Replace Middle Section of Cottonwood Interceptors



Project 23, as identified within the February 2013 WMARSS Large Diameter Interceptor Improvements Report, will **include the construction of open cut replacement of a portion of the Cottonwood Interceptors that are in very poor structural condition from the west side of Old Robinson Road to the east side of US 77**. While the 1989 interceptor is in slightly better structural condition than the 1970 interceptor, field inspections have confirmed that both lines exhibit significant structural degradation and are in danger of failure. Additionally, the 1989 line is generally laid at a higher elevation than the original 1970 line and the 1989 line is exposed (and compromised) at a number of points where the interceptor crosses Cottonwood Creek. **It is recommended that both of the existing Cottonwood Interceptors be replaced with a single pipeline of sufficient capacity and depth.** It is expected that during construction the flows can be routed temporarily into one of the gravity interceptors allowing the new line to be primarily placed in the existing easement. This would minimize the additional easement requirements. After construction, the existing Cottonwood Interceptors would be abandoned in place.

Project 23 (Figure 8-42) is recommended for implementation in the year 2024. Easement acquisition is anticipated for the identified improvements. The WMARSS Large Diameter Interceptor Improvements Report included an estimated project cost for Project 23 of $5,956,000.00. The City of Waco participation amount (currently @ 75.3%) is $4,485,000.00.

Figure 8-42: Project 23: WMARSS Project No. 5 – Replace Middle Section of Cottonwood Interceptors



8.3.24. Project 24: Gravity Line Upstream of Church Road Lift Station

The Speeglevile Basin has experienced significant residential growth over the last 15 years.

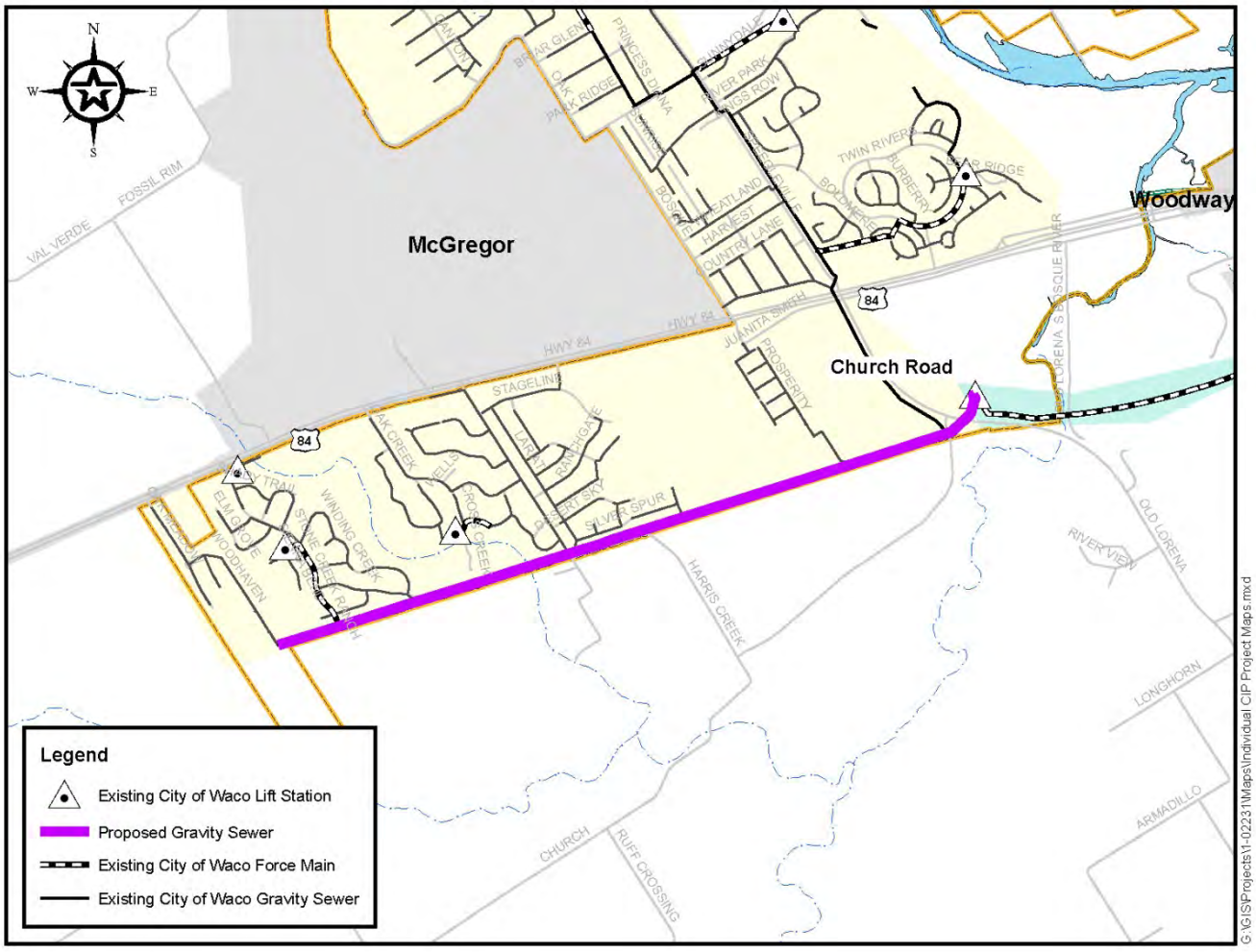
Project 24, as proposed herein, will add hydraulic capacity upstream of the Church Road Lift Station. **Portions of the lower limits of the existing gravity sewer are 8-inch, 10-inch, and 12-inch in diameter and are predicted to be capacity limited within the near future.** The Speegleville Basin has experienced significant growth over the last 15 years. A number of residential subdivisions have been developed that include but are not limited to Sunwest, Harris Creek, Stone Creek Ranch, Prosperity Trail, and Trails of Oak Ridge. The proposed gravity sewer upstream of the Church Road Lift Station will include capacity for future development to the west that includes areas within the City of McGregor's City Limits.

This project should be initiated only after Project 9 (Church Road Lift Station Added Capacity and Force Main Replacement) has been completed which will ensure that the necessary downstream capacity improvements are completed before the upstream improvements are started. Project 24 (Figure 8-44) is recommended for implementation in the year 2024. Easement acquisition is not anticipated for the identified improvements. The total estimated project cost for Project 24 is $6,159,650.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-43: Project 24: 5-year, 6-hour model results – Before Project

Figure 8-44: Project 24: 5-year, 6-hour model results – After Project

Figure 8-45: Project 24: Gravity Line Upstream of Church Road Lift Station



8.3.25. Project 25: Reroute Greenleaf, Village Green, Park Lake and Chimney Hill Lift Stations

Immediate Need Lift Stations
Church Road
Green Leaf
Village Lake

Project 25, as proposed herein, will reroute the Park Lake Lift Station flows from the WMARSS East Bank Interceptor towards the Landon Branch Lift Station and proposed Brazos Basin Interceptor. The Park Lake Lift Station's current firm pumping capacity is 640 gpm. Removing a maximum 640 gpm flows from the WMARSS East Bank Interceptor will free up needed hydraulic capacity in this interceptor since the East Bank Interceptor's current peak flow is greater than the firm pumping capacity of the WMARSS Carver Lift Station. The project also may allow for alterations at the Greenleaf, Village Green, and Chimney Hills Lift Stations.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

Water Utilities staff considers the Park Lake Lift Station to be in very poor condition as well as having deficient pumping capacity. The existing station is located adjacent to Lake Waco and is in a low lying area that is susceptible to flooding when the lake level rises. The Park Lake Lift Station and corresponding 1,990 linear foot cast iron force main were built in 1961, making them 54 years old. Water Utilities staff considers the cast iron force main to be in very poor structural condition. The current lift station is a dry pit station. New pumps and check valves were installed approximately 3 years ago. Water Utilities staff would prefer to change the station from a dry pit station to a submersible station. Additionally, the location of the station needs to be moved due to its proximity to the Lake.

Water Utilities staff considers the Village Green Lift Station to be in fair condition as well as having adequate pumping capacity. The Village Green Lift Station is a dry pit station built in 1970. The lift station and the associated 3,860 linear feet of 8-inch force main are 44 years old. Level floats are utilized on this station because the wastewater composition that enters the station causes false readings when utilizing a level transducer. The force main attached to Lake Shore Drive bridge has not been problematic over the years.

Water Utilities staff has recurring problems with the Park Lake, Village Green and Greenleaf Lift Stations.

Water Utilities staff considers the Green Leaf Lift Station to be in very poor condition as well as being severely under capacity. The Green Leaf Lift Station is a dry pit station built in 1974. The lift station and the associated 670 linear feet of 6-inch force main are approximately 40 years old. The lift station is located adjacent to Lake Waco and is in a low lying area such that the dry pit is susceptible to flooding when the lake level rises. Water Utilities staff would prefer to change the station from a dry pit station to a submersible station. Additionally, the location of the station needs to be moved due to its proximity to the Lake.

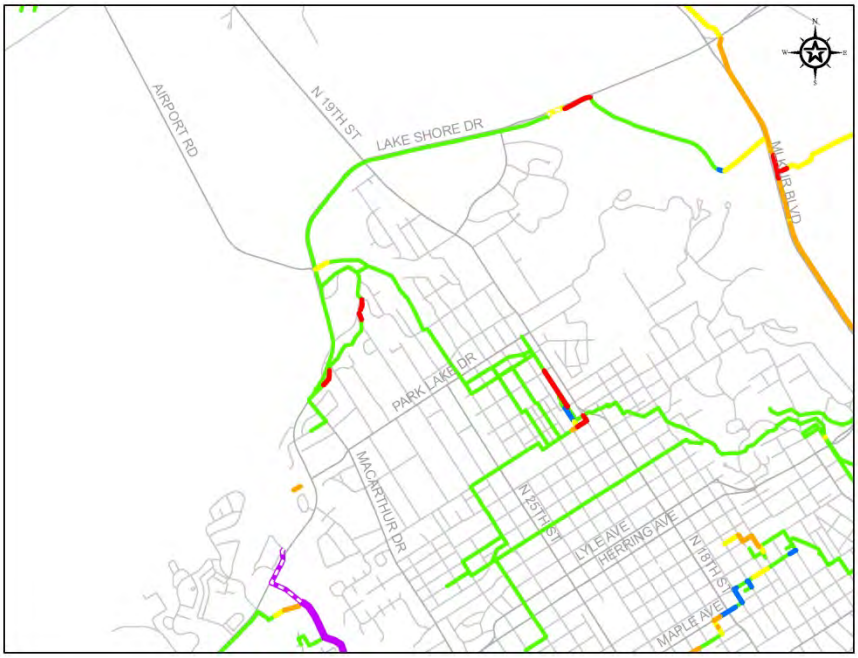
Wastewater flows generated in the Greenleaf, Village Green, and Chimney Hill areas are currently routed through seven lift stations. At the conclusion of the reroute, flows will be routed through as few as

three lift stations (gravity option) or four lift stations (new lift station/force main option).

By first rerouting the Greenleaf and Village Green Lift Stations to the Landon Branch Lift Station will subsequently facilitate the relocating of the Park Lake Lift Station to a location away from its current proximity**.** Two options should be considered in the future. These include a) a new lift station and force main, and b) a gravity sewer alignment which would likely require a trenchless solution for a portion of the final alignment. Refer to Section 7.3.2.6 (Page 7-20) for additional description for the gravity sewer option. In the end, **the improvements will allow for eliminating flooding at the existing station when the lake level rises and will minimize future environmental risks into Lake Waco.**

Figure 8-46: Project 25: 5-year, 6-hour model results – Before Project

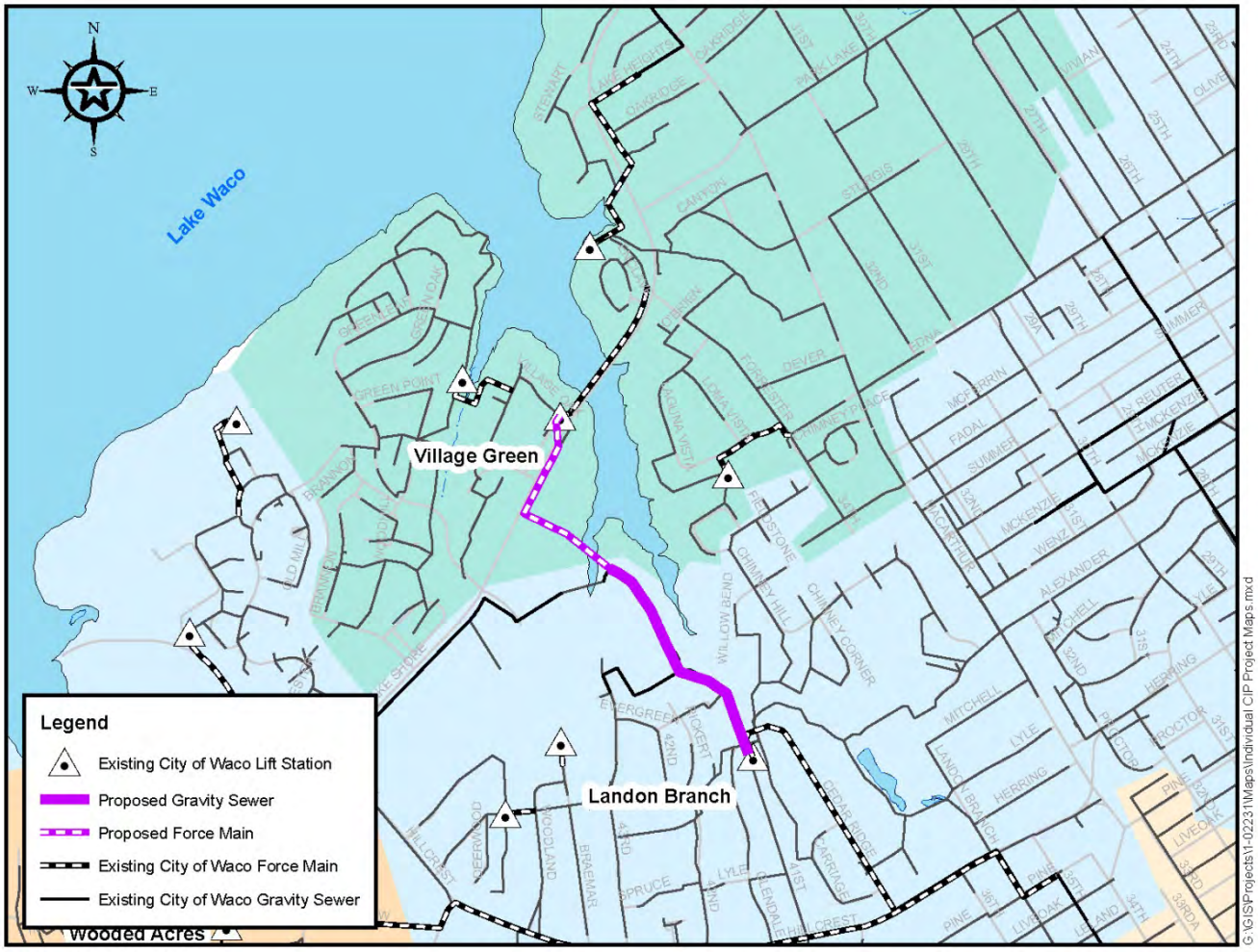
Figure 8-47: Project 25: 5-year, 6-hour model results – After Project



This project should be initiated only after the Project 14 Landon Branch Lift Station Added Pumping Capacity project is completed. With the construction of this project, the City will be provided with a long-term solution to provide more effective conveyance capacity within portions of the Village Lake (China Spring), Carver (WMARSS Carver Lift Station), and MLK Wastewater Basins allowing for future growth in the China Spring area.

Project 25 (Figure 8-48) illustrates the lift station and force main option and is recommended for implementation in the year 2024. Easement acquisition is anticipated for the identified improvements. The total estimated project cost for Project 25 is $1,159,125.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

Figure 8-48: Project 25: Reroute Greenleaf, Village Green, Park Lake and Chimney Hill Lift Stations



8.3.26. Project 26: Syrian Club Lift Station

Project 26, as proposed herein, will replace the existing lift station and force main. **The Syrian Club Lift Station was originally constructed in the mid 1970's and has a reported firm pumping capacity of 200 gpm.** The as-built drawings provide dates of both 1974 and 1976 thereby making the wet well and the associated 6-inch ductile iron pipe force main approximately 40 years old. The site on which the current station is located will not allow for the construction of a replacement station. Therefore, the new station will most likely need to be relocated to other side of Old McGregor Road. Water Utilities staff recommended that the force main be replaced as part of the project.

3-10 Year Lift Stations
Lake Shore
Landon Branch
Lindsey Hollow
Park Lake
Syrian Club
TSTC
McLennan County Jail
Village Green

As part of the lift station assessments phase, it is recommended that this station be replaced during the next 10 year period. **City Water Utilities staff has conveyed that they consider the existing station to be in very poor condition. The existing wet well is very small and with any loss of power, the wet well fills up before Water Utilities staff can get to the site to service.**

The project cost includes the costs associated with replacing the existing 1,420 linear foot force main. It is recommended that the City perform visual testing to better identify the condition of the force main to confirm that replacement is warranted at the time the station is replaced. One such option that Water Utilities could consider is to identify two or more locations (either a high maintenance location or location near a high point in the line) where the force main could be dug up and a joint of the existing line be removed in order to provide an indication of the condition of the existing line**. It is understood that the existing ductile iron force main is not lined to protect the pipe in sewer applications.**

The Syrian Lift Station is approximately 40 years old and should be replaced within the next 10 year period.

Project 26 is recommended for implementation in the year 2024. Easement (property) acquisition is anticipated for the identified improvements. The total estimated project cost for Project 26 is $1,060,800.00. Appendix D presents an associated one-page CIP Project Form, which provides the itemized breakdown for the total estimated project cost.

8.4. 11-20 Year Projects

Figure 8-49 provides a listing of projects that the City of Waco should consider in the 11-20 Year timeframe. Each project should be evaluated carefully as part of a subsequent wastewater collection system master plan update. The evaluation shall include updating the project scoring criteria to determine how each project ranks priority wise due to growth, structural integrity, hydraulic capacity and risk avoidance. Within Chapter 7 (Sections 7.3.2 and 7.3.5), a number of wastewater projects were identified that will accommodate future development. These projects were identified as part of this effort but did not have a resultant rating to merit inclusion within the proposed 1-10 Year Capital Improvement Program project listing. Projects that are driven by development should be supported by an impact fee that will appropriately allocate monies back into the City's utility fund to assist in paying for asset renewal (rehabilitation and replacement) type projects and added capacity type projects.

11-20 Year projects include Future Asset Renewal, WMARSS and City of Waco Projects.

Future Asset Renewal Projects

1 & 2. Asset Renewal Projects Number 4 and 5 are discussed in Chapter 7 (Page 7-1 through 7-6) and are scheduled for years 2027-2030 and 2031-2034. The City chose a plan such that 20% of the existing small diameter lines (approximately 600,000 linear feet of pipe) that are currently in very poor structural condition would be replaced or rehabilitated within the next 20-year planning horizon. **This equates to replacing or rehabilitating approximately 1% of the collection system's structural "hot-spot" lengths per year for the next 20 years.** The plan is to addresses aged gravity sewers on the verge of structural failure (as well as to remove ground water infiltration from the system) and provide additional hydraulic capacity in locations that are currently deficient during wet weather events.

Future WMARSS Projects

3. Flat Creek Interceptor Extension (Page 7-31)

4. Carver Lift Station (Page 7-25)

Future City of Waco Projects

5. Flat Rock Lift Station Abandonment (Page 7-16)

6. Lincoln Park and Chicken Shack Lift Station Abandonment – Rerouting the Lincoln Park Lift Station flows will remove flows along McKeen Street to free up needed capacity within the existing line as well as removing flows from the East Bank Interceptor in the area is crosses IH-35 at Martin Luther King intersection. Rerouting the Chicken Shack Lift Station flows will remove flows from the WMARSS East Bank Interceptor

from Waco Drive to the east side of the Baylor Football Stadium (Page 7-22)

11-20 Year Lift Stations
Bosque
Flat Rock
Hillcrest
Twin Rivers

7. Primrose Reroute – reroute flow from Transfer Lift Station along 12th Street and to the WMARSS Cottonwood Creek interceptor(s). Discussed with Garrett and Jupe and supported. Per Ricky existing line along 12th is VCP and is problematic, so the possibility of replacing the existing line overall would be beneficial.

8. Village Lake Interceptor Extension / Bosqueville, Avon, Mammoth Site, and River Bend Ball Fields Lift Station Abandonment (Page 7-18 and 7-32)

9. Speegleville Basin WWTP (Page 7-34 through 7-37)

10. South 26th Street @ IH-35 - reroute flows from Primrose Basin to the proposed Brazos Interceptor.

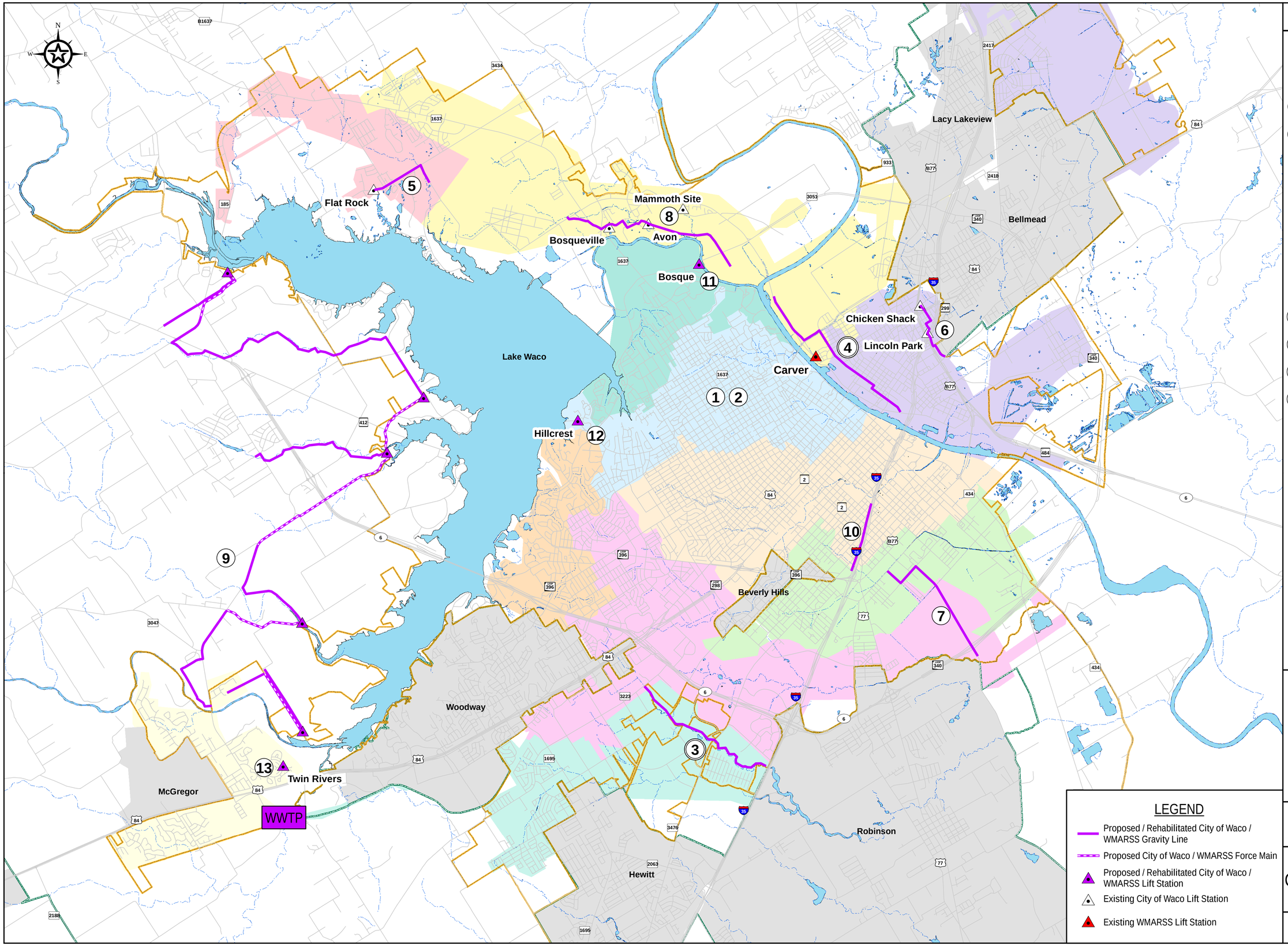
11. Bosque Lift Station (Pages 6-5 through 6-10)

12. Hillcrest Lift Station (Pages 6-5 through 6-10)

13. Twin Rivers Lift Station (Pages 6-5 through 6-10)

8.5. Project Implementation Schedule (Sequence of CIP Construction Projects)

The Project Implementation Schedule is shown in Figure 8-50. It provides a project flow chart schematic that designates the timing of each project within the 1-10 Yr. Capital Improvement Program. The schedule specifies the various predecessor and successor relationships of each of the projects in order to ensure that additional impairments to the collection system will not be triggered should the projects be constructed out of sequence. The project implementation schedule includes each of the 1-10 Yr. City of Waco identified projects as well as the WMARSS projects that were identified within the WMARSS 3-10 Yr. CIP as part of the February 2013 WMARSS Large Diameter Interceptor Improvements Report.



CIP Project Index

1. 2027-2030 Asset Renewal Project No. 4
2. 2031-2034 Asset Renewal Project No. 5
3. Flat Creek Interceptor Extension (WMARSS Project) (Page 7-31)
4. Carver Lift Station (WMARSS Project) (Page 7-25)
5. Flat Rock Lift Station Abandonment (Page 7-16)
6. Lincoln Park and Chicken Shack Lift Station Abandonments (Page 7-22)
7. Primrose Reroute
8. Village Lake Interceptor Extension (Page 7-18 and 7-32)
9. Speegleville Basin Wastewater Treatment Plant (Page 7-34 through 7-37)
10. South 26th Street @ IH-35
11. Bosque Lift Station
12. Hillcrest Lift Station
13. Twin Rivers Lift Station

LEGEND

- Proposed / Rehabilitated City of Waco / WMARSS Gravity Line
- Proposed City of Waco / WMARSS Force Main
- Proposed / Rehabilitated City of Waco / WMARSS Lift Station
- Existing City of Waco Lift Station
- Existing WMARSS Lift Station

CITY OF WACO

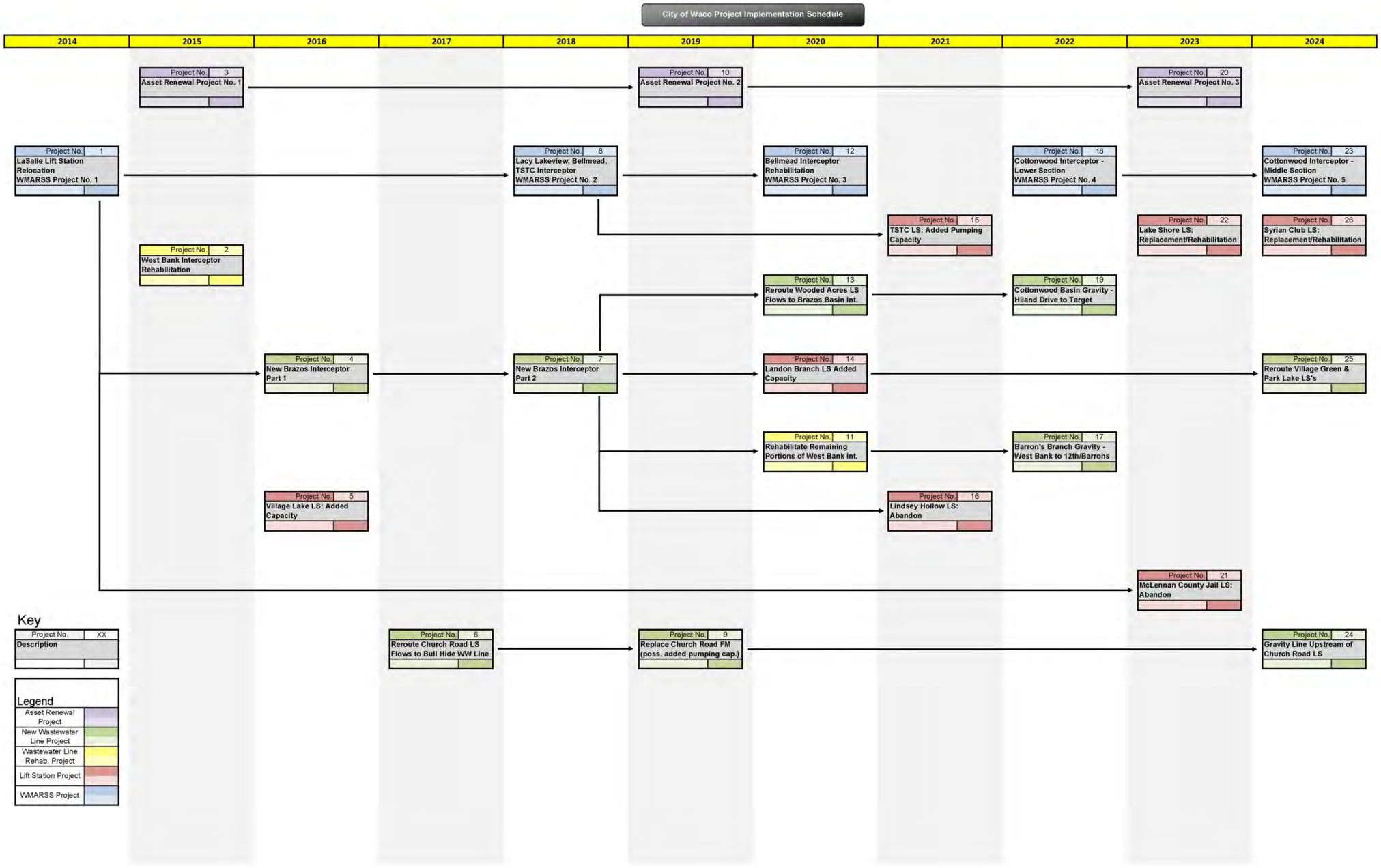
0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 8-49: 11-20 Year Capital Improvement Plan Projects

G:\GIS\Projects\11-02231\Maps\11-20 Yr CIP.mxd

Figure 8-50 1-10 Year Project Implementation Schedule



CHAPTER 9 – SUMMARY

9.1. Conclusions and Recommendations

The greater part of the recommendations made within the final 1-10 Year Capital Improvement Program are for the enhancement of the functionality and general structural condition of the wastewater collection system and improvement of historical operational and maintenance issues. Below are a number of suggestions to help the City to achieve these goals:

- City should further integrate a maintenance management system with the City's current GIS system to collect maintenance findings by asset. Condition data should be collected and stored as part of maintenance and inspection visits.
- City should continue implementing their cleaning program (grease treatment and root control) as part of its Sanitary Sewer Overflow Initiative agreement with the TCEQ. This program has resulted in a reduction of sanitary sewer overflows over the last four years. The City should continue carrying out the training of cleaning crew personnel as part of this program.
- City should continue to generate repair work orders by inspection personnel (CCTV crew) that can be completed by Water Utilities staff. Repairs that are larger in scope and cannot be completed by internal staff, the City should assign these to the "Asset Renewal" inventory and rank them against the previously identified locations. Water Utilities staff should develop a standardized methodology to govern repair, rehabilitation, and replacement requirements in order to ensure consistent decision-making and should be thoroughly trained in the coding of defects to enable the collection of consistent records should there be a turnover of personnel.
- City should develop a plan to inspect large diameter (18-inch and larger) sewers over the next 10-Year period to identify which segments suffer from maintenance or structural deficiencies.
- City should develop a formal project prioritization process to confirm that the highest risk and/or highest consequence assets are addressed in order to assure stakeholders that available resources are focused on the highest priority projects.
- City should develop some type of legal resolution to the ongoing prescriptive easement issue. There are numerous locations across older parts of town where sewer lines have no easement. The gravity sewers lie underneath buildings or in locations making access for maintenance virtually impossible. In some cases the property owners prohibit City crews from entering their property in order to repair or replace gravity sewers based upon their claim that the City has no easement.

Table 9-1 presented on the following page presents the summary of the 1-10 Year plan presented in Chapter 8. The summary includes the estimated project costs. Figure 8-1 (located in Appendix D) provides the locations for the various 1-10 Year projects.

Table 9-1:
City of Waco Collection System 1 to 10-Year Capital Improvement Program Summary

	Project Number	Description	Estimated Cost[1 & 2]	Cumulative Cost
2015-2024 Improvements				
2015	1	WMARSS Project No. 1 - LaSalle Lift Station Relocation & Force Main Extension to Central Plant	$30,660,000	$30,660,000
	2	West Bank Interceptor Rehabilitation (Part 1)	$2,280,100	$32,940,100
	3	2015-2018 City Identifed Asset Renewal Project No. 1 - Projects 1-51: Replace/Rehabilitate Approximately 135,000 LF (~3.8%) of Structurally Deficient Lines	$39,128,500	$72,068,600
2016	4	Brazos Basin Interceptor (Lower Limits - Project 1)	$21,037,800	$93,106,400
	5	Village Lake Hydraulic Capacity Improvements	$1,766,900	$94,873,300
2017	6	Reroute Church Road Lift Station Flows to Bull Hide /Castleman Creek Wastewater Line	$2,355,425	$97,228,725
2018	7	Brazos Basin Interceptor (Upper Limits - Project 2)	$12,658,250	$109,886,975
	8	WMARSS Project No. 2 - Lacy Lakeview / Bellmead / TSTC Interceptor	$8,908,000	$118,794,975
2019	9	Church Road Lift Station Added Capacity and Force Main Replacement	$4,441,700	$123,236,675
	10	2019-2022 Asset Renewal Project No. 2: Replace/Rehabilitate Approximately 140,000 LF (4%) of Structurally Deficient Small Diameter Lines	$35,000,000	$158,236,675
2020	11	West Bank Interceptor Rehabilitation (Part 2)	$2,362,750	$160,599,425
	12	WMARSS Project No. 3 - Rehabilitate Bellmead Interceptor	$2,179,000	$162,778,425
	13	Reroute of Wooded Acres Lift Station Flows from Cottonwood Basin to Brazos Basin Interceptor	$1,626,525	$164,404,950
	14	Added Pumping Capacity at Landon Branch Lift Station	$1,559,300	$165,964,250
2021	15	Added Capacity TSTC Lift Station and Force Main Improvements	$6,463,525	$172,427,775
	16	Abandon Lindsey Hollow Lift Station and Gravity Extension	$2,817,750	$175,245,525
2022	17	Barron's Branch Added Capacity Wastewater Line	$4,277,825	$179,523,350
	18	WMARSS Project No. 4 - Replace Lower Limits of Cottonwood Interceptors	$5,683,000	$185,206,350
	19	Cottonwood Basin Added Capacity Wastewater Line	$8,272,400	$193,478,750
2023	20	2023-2026 Asset Renewal Project No. 3: Replace/Rehabilitate Approximately 140,000 LF (4%) of Structurally Deficient Small Diameter Lines	$35,000,000	$228,478,750
	21	Abandon McLennan County Jail Lift Station and Gravity Extension to WMARSS LaSalle Lift Station	$1,187,000	$229,665,750
	22	Lake Shore Lift Station	$1,764,325	$231,430,075
2024	23	WMARSS Project No. 5 - Replace Middle Section of Cottonwood Interceptors	$4,485,000	$235,915,075
	24	Gravity Line Upstream of Church Road Lift Station	$6,159,650	$242,074,725
	25	Reroute Greenleaf, Village Green, Park Lake and Chimney Hill Lift Stations	$1,159,125	$243,233,850
	26	Syrian Club Lift Station	$1,060,800	**$244,294,650**
		TOTAL ESTIMATED COST OF PROJECTS	**$244,294,650**	

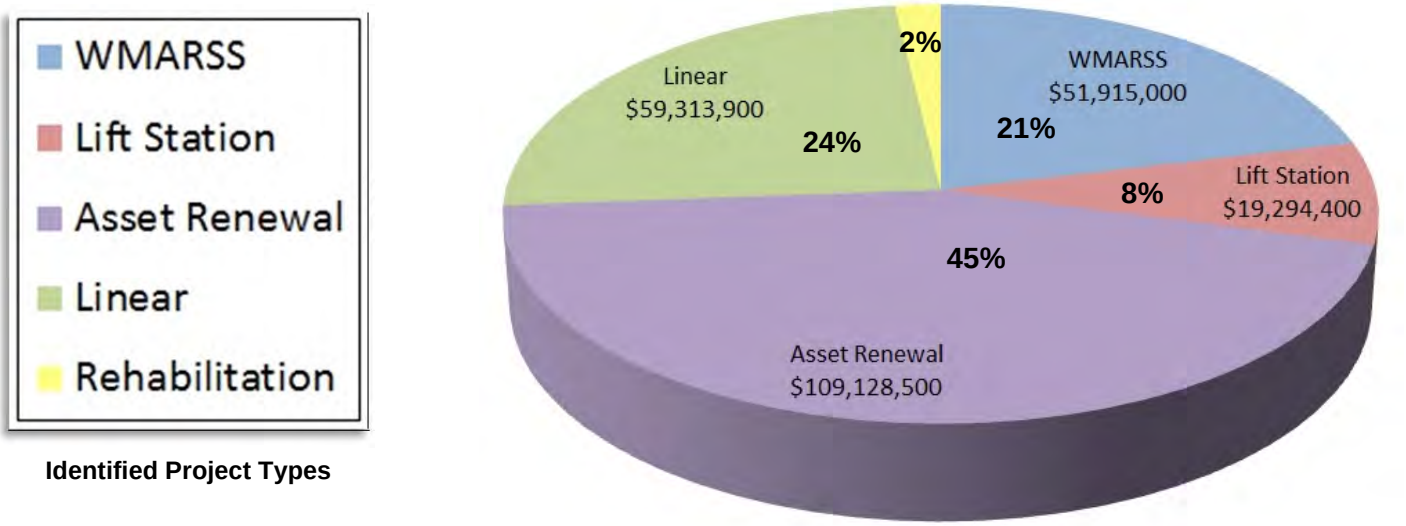
(1) Inflation is not included in estimated costs

(2) Includes Engineering/Construction Contingencies (37.5%) and Land Acquisition Costs

The total 1-10 Year Capital Improvement Program cost is approximately $245 Million. These estimated costs are given in 2015 dollars without escalation. Cost escalation can be incorporated into future detailed cost estimates. The final cost of any project depends on a number of items which may include project complexity, labor and material costs, competitive market conditions, actual site conditions, final scope of work, implementation schedule, engineering, and Right-of-Way or easement acquisition.

Figure 9-1 shows the projects lumped together by the five recognized project types.

Figure 9-1: CIP Cost Allocation by Project Type



Approximately 47% of the estimated program cost is exclusively to address the rehabilitation and/or replacement of existing deficient City of Waco assets (that is “Rehabilitation” and “Asset Renewal” classified type projects). Based upon the dry and wet weather flow monitoring, it was seen that many portions of the system experience high inflow and infiltration. In addition to the two categories referenced above, significant portions of the “Linear”, “WMARSS” and “Lift Station” type projects have also been prioritized taking into account the poor structural condition of the existing assets. Overall, Waco’s existing wastewater infrastructure limits future economic development, downtown redevelopment, and residential development due to the deterioration and lack of capacity of the existing assets. The City’s ultimate roadmap to success includes rehabilitating the current system while sensibly expanding for future growth.

Substantial quantities of flows are proposed to be rerouted as part of the 1-10 Year projects to improve operation during wet weather rain events. The Master Plan should be updated at such time that many of

these reroutes are completed. Many cities reexamine their master plans at a 5-year time period. For the City of Waco, this timeframe should allow for significant flow reroutes and added capacity projects to be completed, thus allowing for further temporary flow monitoring to take place. Future temporary flow monitoring will enable the City to capture and measure peak wet weather flows within the collection system. This objective was not successful at a number of meter sites as part of the metering efforts within this master planning effort.

The 2015 Wastewater Collection System Master Plan will make sure that City of Waco residents and businesses are provided with efficient and reliable wastewater service. The challenge for the City will be to effectively finance the implementation of the Capital Improvement Program. Projects have been distributed to appropriate future years to provide a fiscal year cash flow projection. As a result, the implementation of the projects can be tailored to meet the needs of the Water Utilities department, as well as economic and cash flow requirements.

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BB-1	Barrons Branch	Landon Branch	1955

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,220	814099	743024	150±	From: North of Wendy Ln & Pine Ave To: Hillcrest Dr & Woodland Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8" VCP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☑ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☐ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

In a heavily wooded area, difficcult to access; no access from Hillcrest Dr; no easement for sewer line; need to verify which line services for the houses along Old Oaks Dr run to; power lines present

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$21,000.00	$21,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	12.5	$4,000.00	$50,000.00
Sanitary Sewer Service	EA	10	$1,250.00	$12,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	1220	$95.00	$115,900.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	7	$7,500.00	$52,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	45	$200.00	$9,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$280,900.00
Soft Costs (35%)				$98,300.00
Easement Acquisition (25' Width x 1220' Length x $0.35 per square foot)				$10,700.00
Total Estimated Project Cost				$389,900.00

C.O.W. Rank: 41

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BB-2	Barrons Branch	Landon Branch	1969

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,050	744042	741011	1000±	From: Greenleaf Dr To: Creek north of Evergreen Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
12"-15" VCP	15"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 20 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

When first built, had inverted siphon crossing under creek, now aerial crossing (City Staff); runs beneath Village Green Apartments parking lot; in a heavily wooded area, difficult to access; aerial crossing in area east of apartments; Evaluate Village Green LS reroute (3-10 Year CIP Project No. 23)

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☑ Other: Apartments
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$38,000.00	$38,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	355	$300.00	$106,500.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	460	$140.00	$64,400.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	1235	$140.00	$172,900.00
Construction Subtotal				$505,100.00
Soft Costs (35%)				$176,800.00
Easement Acquisition (25' Width x 2050' Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$681,900.00

C.O.W. Rank: 6 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BB-3	Barrons Branch	Barron's Branch	1968, 1989

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,020	503059	614096	3450±	From: East of McKenzie Ave & N 15th St To: Methodist Home Private Dr

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8"-24"	21"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	10 & 25 ft.	☑ Unable to Access
☐ Inadequate Hydraulic Capacity	☑ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.

Comments

Pipe type used during 1989 rehab needs to be field verified; heavily wooded area, difficult to access; multiple aerial crossings; line in wooded area to the private drive, including two aerial crossings, was replaced in 1989

Highly Wooded Area

Land Use / Surface Cover:

☐ Rural Residential		☐ Street/Alley	
☐ Single Family Residential		☐ Parking Lot	
☐ Public/Semi-Public		☐ Yard	
☐ Parks/Open Space		☐ Field	
☐ Commercial		☑ Trees/Wood	
☐ Industrial		☑ Creek	
☐ Other: Methodist Home		☐ Other: _____	

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$39,000.00	$39,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	12.5	$4,000.00	$50,000.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	260	$300.00	$78,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	320	$95.00	$30,400.00
12" Gravity (All Depths) - Urban	LF	60	$120.00	$7,200.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	1070	$175.00	$187,250.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	8	$10,500.00	$84,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	55	$275.00	$15,125.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$523,500.00
Soft Costs (35%)				$183,200.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$706,700.00

C.O.W. Rank: 30

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BB-4	Barrons Branch	Barron's Branch	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,360	503032	503026	75±	From: East of Summer Ave & Fall St To: Methodist Home School Building

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
10"	12"	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility	
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☐ Existing Easement	ft.	☑ Unable to Access	
☐ Inadequate Hydraulic Capacity	☑ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:	
☐ Other: _____		☑ Requires Easement	25 ft.	Building, sign, etc.	

Comments

Located on the north-northeast side of the Methodist Home; no record drawings; noted choked-down aerial near the northwest corner of the school building (City Staff); some heavily wooded areas, difficult to access;

Highly Wooded Area

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☐ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☑ Trees/Wood
☐ Industrial	☑ Creek
☐ Other: Methodist Home	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$33,000.00	$33,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	7.5	$4,000.00	$30,000.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	100	$300.00	$30,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	1710	$95.00	$162,450.00
12" Gravity (All Depths) - Urban	LF	550	$120.00	$66,000.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	12	$7,500.00	$90,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$444,700.00
Soft Costs (35%)				$155,600.00
Easement Acquisition (25' Width x 2360' Length x $0.35 per square foot)				$20,700.00
Total Estimated Project Cost				$621,000.00

C.O.W. Rank: 13

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BR-1	Bosque River	Chimney Hill	1967

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
940	591044	592092	20±	From: East of Loma Vista Dr To: North of bend on Laguna Vista Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 45 ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Sewer line alignment follows centerline of Laguna Vista Dr;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$12,000.00	$12,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	14	$1,250.00	$17,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	940	$100.00	$94,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	4	$7,500.00	$30,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	20	$200.00	$4,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$157,500.00
Soft Costs (35%)				$55,100.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$212,600.00

C.O.W. Rank: 49

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BR-2	Bosque River	Bosque River	1955, 1974

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4,660	522025	372044	450±	From: N 30th St To: Shady Glen Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10" VCP	8"-12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☑ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☑ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☑ Existing Easement 15 - 30 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Sewer line along both sides of the creek; services to the rear of the properties; heavily wooded area, difficult to access; sewer line on east side of creek is 6", line on west side is 8-10"; aerial crossing located in the area to the northeast of Maple Hill Ci cul-de-sac;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$65,000.00	$65,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	40	$4,000.00	$160,000.00
Sanitary Sewer Service	EA	12	$1,250.00	$15,000.00
Aerial Crossing	LF	10	$300.00	$3,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$15,000.00	$15,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	1260	$65.00	$81,900.00
8" Gravity (All Depths) - Urban	LF	20	$100.00	$2,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	3320	$95.00	$315,400.00
12" Gravity (All Depths) - Urban	LF	60	$120.00	$7,200.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	24	$7,500.00	$180,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	100	$200.00	$20,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$874,500.00
Soft Costs (35%)				$306,100.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,180,600.00

C.O.W. Rank: 1

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BR-3	Bosque River	Bosque River	1955

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,950	521002	521020	50±	From: N 25th St To: Creek east of N 27th St & Stewart Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference:
  Building, sign, etc.

Comments

Heavily wooded area, difficult to access; line runs through rear of lots, no easment shown on record drawings; aerial crossing near tie in to 18" line near creek;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$27,000.00	$27,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	18	$4,000.00	$72,000.00
Sanitary Sewer Service	EA	10	$1,250.00	$12,500.00
Aerial Crossing	LF	50	$300.00	$15,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	1930	$65.00	$125,450.00
8" Gravity (All Depths) - Urban	LF	20	$100.00	$2,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	12	$7,500.00	$90,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	25	$200.00	$5,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$359,000.00
Soft Costs (35%)				$125,700.00
Easement Acquisition (25' Width x 1950' Length x $0.35 per square foot)				$17,100.00
Total Estimated Project Cost				$501,800.00

C.O.W. Rank: 12

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BR-4	Bosque River	Bosque River	1955

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,620	N/A	372021	50±	From: Stewart Dr & N 24th St To: Creek west of N 23 St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

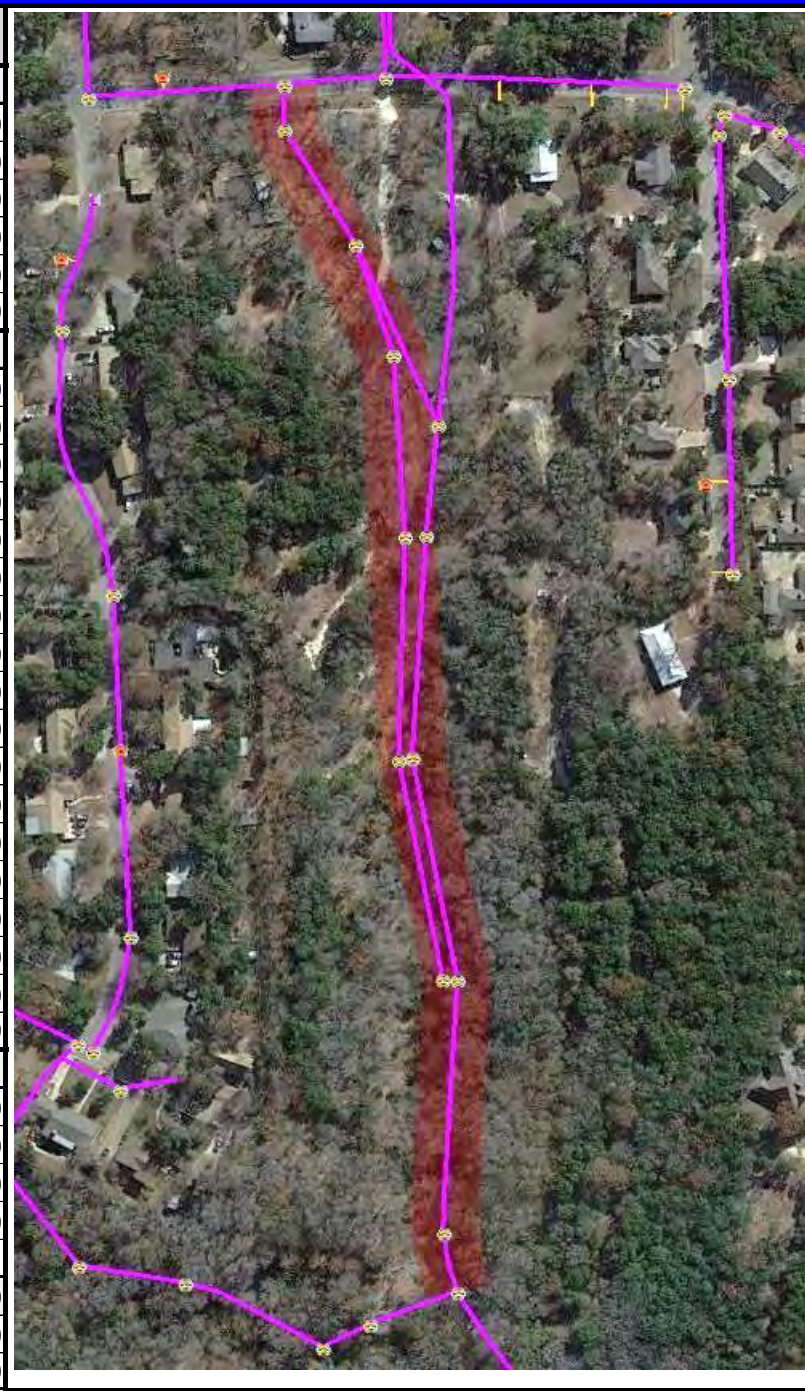
Verify pipe size and line activity; possible parallel abandoned force main; heavily wooded area, difficult to access; manholes not found (City Staff); line may have been rehabed in mid 80s; easement not shown on record drawings

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$20,000.00	$20,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	16	$4,000.00	$64,000.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	1560	$65.00	$101,400.00
8" Gravity (All Depths) - Urban	LF	60	$100.00	$6,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	8	$7,500.00	$60,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$268,900.00
Soft Costs (35%)				$94,100.00
Easement Acquisition (25' Width x 1600' Length x $0.35 per square foot)				$14,000.00
Total Estimated Project Cost				$377,000.00



C.O.W. Rank: 23 **By:** JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BR-5	Bosque River	Bosque River	1955, '84, '95

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,780	514045	372021	1000±	From: Stewart Dr & N 20th St To: Creek west of N 23 St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10" VCP, PVC, DIP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☑ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 20 & 30 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Section of sewer lines from Stewart Dr to Cedar Mountain Dr was replaced in 1994, section near end may have been rehabed in mid 80s; heavily wooded area, difficult to access; line runs through rear of lots; aerial crossing on line coming from Gregory Ln

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$43,000.00	$43,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	18	$2,000.00	$36,000.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	150	$300.00	$45,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	35	$65.00	$2,275.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	2010	$95.00	$190,950.00
12" Gravity (All Depths) - Urban	LF	620	$120.00	$74,400.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	18	$7,500.00	$135,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$572,900.00
Soft Costs (35%)				$200,500.00
Easement Acquisition (25' Width x 150' Length x $0.35 per square foot)				$1,400.00
Total Estimated Project Cost				$774,800.00

C.O.W. Rank: 36 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-1	Brazos	Waco Creek South	1976

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
860	1051041	1054014	125±	From: Memorial Dr To: Acree St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8" VCP	8"	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☑ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Heavily wooded area; difficult to access; line runs through properties; aerial crossing across creek in middle of sewer line

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☐ Parking Lot
- ☑ Yard
- ☐ Field
- ☑ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$15,000.00	$15,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	5.5	$4,000.00	$22,000.00
Sanitary Sewer Service	EA	8	$1,250.00	$10,000.00
Aerial Crossing	LF	90	$300.00	$27,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	525	$65.00	$34,125.00
8" Gravity (All Depths) - Urban	LF	245	$100.00	$24,500.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	25	$200.00	$5,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$195,100.00
Soft Costs (35%)				$68,300.00
Easement Acquisition (25' Width x 860' Length x $0.35 per square foot)				$7,600.00
Total Estimated Project Cost				$271,000.00

C.O.W. Rank: 45 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-2	Brazos	Waco Creek South	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.
370	1041065	1041003	25±

Location (Nearest Street Intersection)

From: West side of Franklin Ave & Valley Mills Dr

To: South side of Franklin Ave & Valley Mills Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)
8-10" CIP	12"

Recommended Replacement Type

- [x] Open Cut
- [ ] Other: _____
- [x] Trenchless

Noted Condition(s)

- [x] Stuctural Deterioration/Failure
- [ ] Inadequate Hydraulic Capacity
- [ ] Other: _____
- [x] Fat, Oil, and Grease
- [ ] Aerial Crossing(s)

R.O.W. / Easements (Width)

- [ ] Existing Easement ft.
- [ ] Existing R.O.W ft.
- [ ] Requires Easement ft.

Accessibility

- [ ] Unable to Access
- [ ] Interference:

Building, sign, etc.

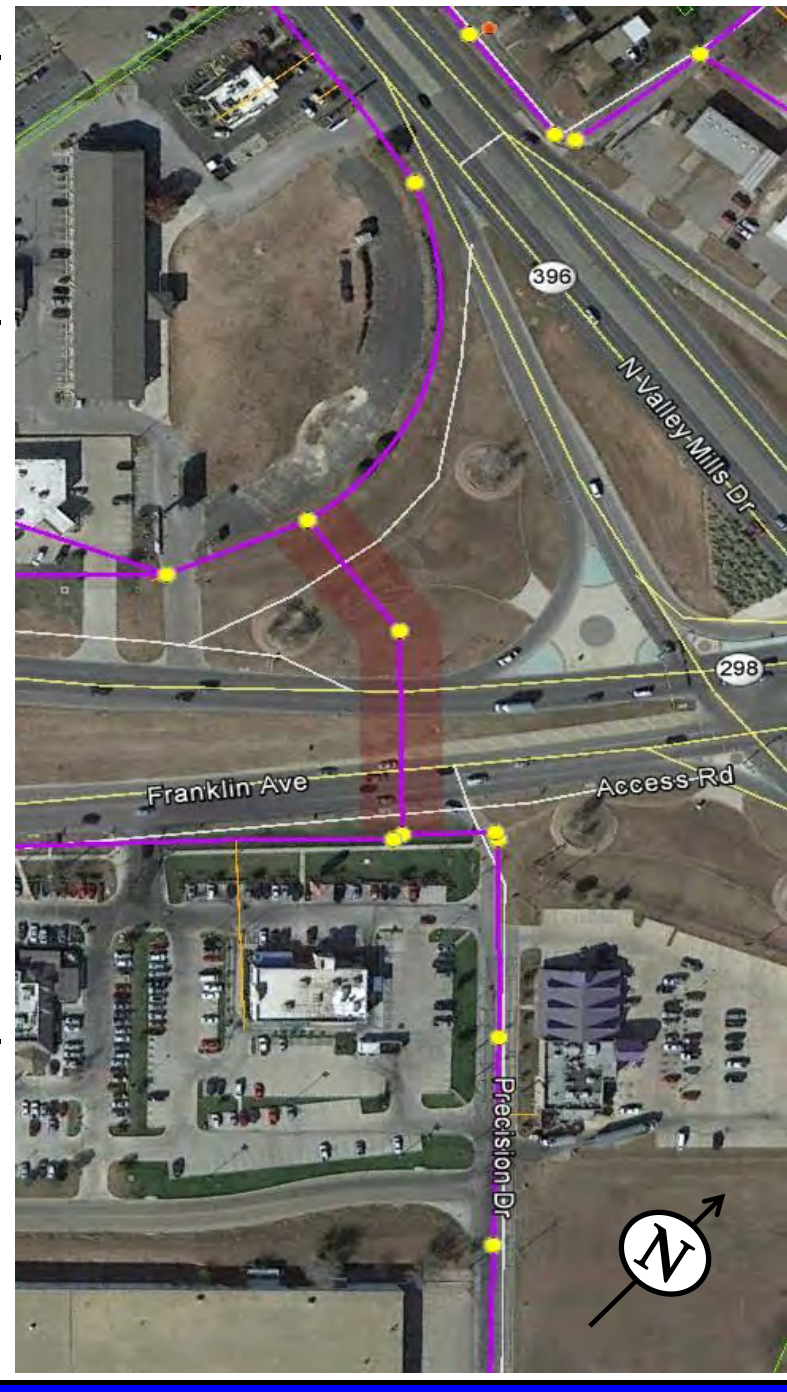
Comments

Franklin Ave crossing; 10" CIP was installed in 1999; field verify condition of exisiting encasement pipe; no record drawing of installation of 10" pipe; cost estimate assumes the need for a new encasement pipe

Land Use / Surface Cover:

- [ ] Rural Residential
- [ ] Single Family Residential
- [x] Public/Semi-Public
- [ ] Parks/Open Space
- [x] Commercial
- [ ] Industrial
- [ ] Other:
- [x] Street/Alley
- [ ] Parking Lot
- [ ] Yard
- [ ] Field
- [ ] Trees/Wood
- [ ] Creek
- [ ] Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$10,000.00	$10,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	370	$95.00	$35,150.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	160	$325.00	$52,000.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	3	$7,500.00	$22,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	15	$200.00	$3,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$122,700.00
Soft Costs (35%)				$42,900.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$165,600.00



C.O.W. Rank: 14

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-3	Brazos	Waco Creek South	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
				From: Precision Dr (near Galaxy Theater)
1,910	1054034	1054030	100±	To: Valley Mills Dr Access Road Turn-Around

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
10" VCP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☑ Fat, Oil, and Grease
- ☐ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☑ Existing Easement 10 ft.
- ☑ Existing R.O.W 60 ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

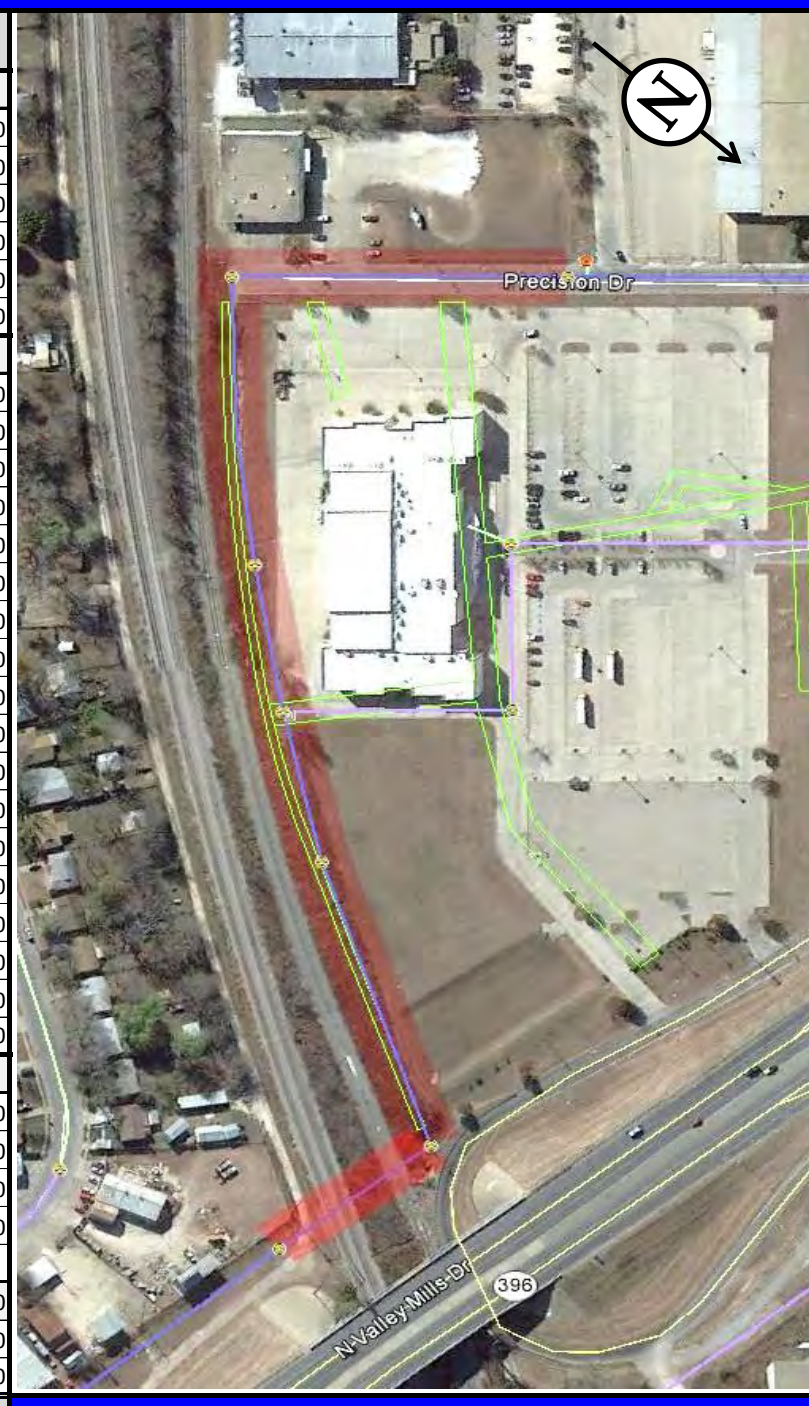
Comments

Sewer line runs parallel to railroad tracks; RoW on Precision Dr; sewer line outside of RR RoW, no easement noted on drawings;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$28,000.00	$28,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	1460	$95.00	$138,700.00
12" Gravity (All Depths) - Urban	LF	450	$120.00	$54,000.00
18" Boring and Casing	LF	240	$325.00	$78,000.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	40	$200.00	$8,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$369,200.00
Soft Costs (35%)				$129,200.00
Easement Acquisition (25' Width x 1220' Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$498,400.00



C.O.W. Rank: 48

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-4	Brazos	Waco Creek South	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
6,890	943020	832018	2000±	From: Mary Ave To: Railroad Tracks north of Webster Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6"-27" VCP	8", 12", 27", 36"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☑ Other: Siphon

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☑ Unable to Access
- ☑ Interference: Building, sign, etc.

Comments

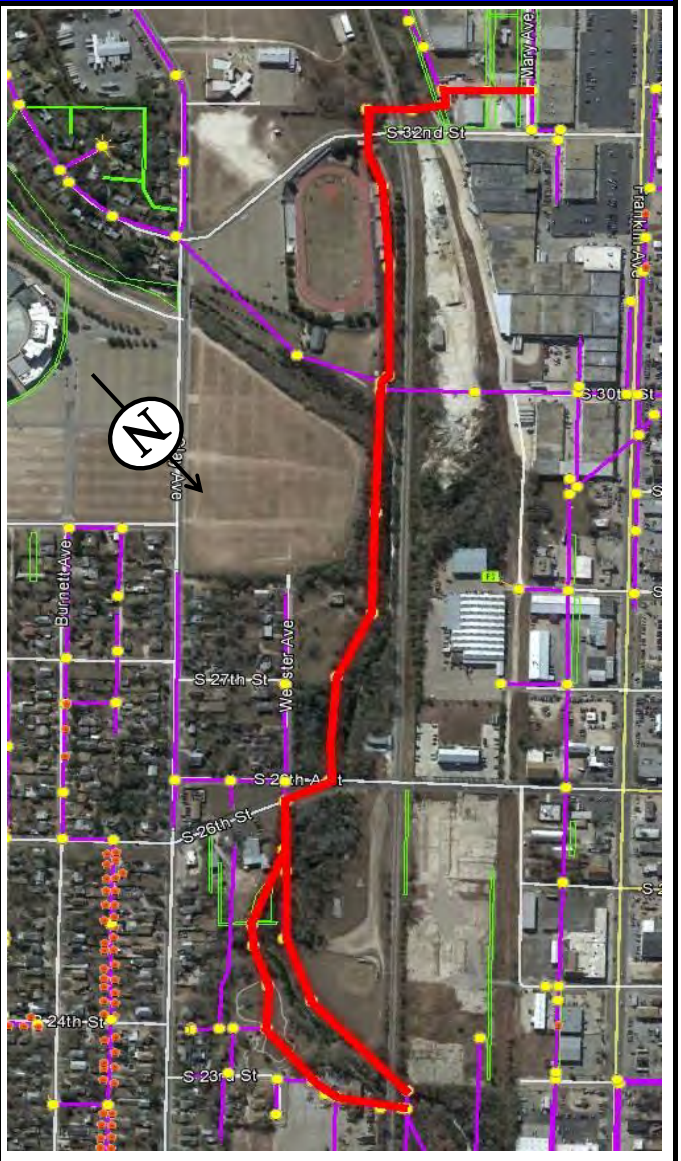
Unable to locate manholes and lines; poor backfill; small section in the street along S 26th St; **24" Inverted siphon under creek between manhole northwest of open field (1977)**; aerial crossing on 18" West line after 26th St; no easement shown on record drawings; consider reroute down 32nd to avoid buildings

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☑ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$117,000	$117,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	35	$4,000.00	$140,000.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	70	$300.00	$21,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	120	$65.00	$7,800.00
8" Gravity (All Depths) - Urban	LF	350	$100.00	$35,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	565	$95.00	$53,675.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	90	$325.00	$29,250.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	12	$10,500.00	$126,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	100	$275.00	$27,500.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
27" Gravity (All Depths) - Rural	LF	1890	$225.00	$425,250.00
36" Gravity (All Depths) - Rural	LF	1670	$300.00	$501,000.00
Construction Subtotal				$1,573,500.00
Soft Costs (35%)				$550,700.00
Easement Acquisition (25' Width x 4600' Length x $0.35 per square foot)				$40,300.00
Total Estimated Project Cost				$2,164,500.00



C.O.W. Rank: 24 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-5	Brazos	Waco Creek South	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,480	944046	944037	1150±	From: Oriental Rd (along Mecca Rd & Karem Rd) To: Austin Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10" VCP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☐ Existing Easement	ft.	☐ Unable to Access
☐ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☑ Existing R.O.W	45 ft.	☐ Interference:
☑ Other: Siphon		☐ Requires Easement	ft.	Building, sign, etc.

Comments

Siphon along Oriental Rd crossing the creek (10" and 6") installed in 1992; exposed 10" pipe in creek near Austin Ave; no record drawings for line on Karem Rd; consider upsizing line on Karem to remove siphon;

Land Use / Surface Cover:

☐ Rural Residential	☑ Street/Alley
☑ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☑ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☐ Trees/Wood
☐ Industrial	☐ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$32,000.00	$32,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				$0.00
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	1205	$100.00	$120,500.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	360	$95.00	$34,200.00
12" Gravity (All Depths) - Urban	LF	915	$120.00	$109,800.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	12	$7,500.00	$90,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$429,800.00
Soft Costs (35%)				$150,400.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$580,200.00

C.O.W. Rank: 3 | **By:** JRH | **Date:** 5/28/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-6	Brazos	Waco Creek North	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
790	N/A	834015	0	From: N 23rd St To: East of N 25th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10"	6", 12"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☑ Interference: Building, sign, etc.

Comments

Services in rear of the property; line runs beneath Waco Charter School building; flows from rear of lots to manhole northeast of building; line under building flows from front to back of building; no record drawings; reroute around building

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☑ Parking Lot
- ☑ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$10,000.00	$10,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	8	$1,250.00	$10,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	210	$120.00	$25,200.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	30	$200.00	$6,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	370	$95.00	$35,150.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$133,900.00
Soft Costs (35%)				$46,900.00
Easement Acquisition (25' Width x 570' Length x $0.35 per square foot)				$5,000.00
Total Estimated Project Cost				$185,800.00

C.O.W. Rank: 15

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-7	Brazos	Waco Creek North	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
320	834007	N/A		From: Fort Ave To: Waco Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)
- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)
- ☑ Existing Easement 10 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility
- ☐ Unable to Access
- ☑ Interference: Building, sign, etc.

Comments

Line is located between N 23rd and N 24th St; potential pipe-bursting project; line runs through the rear of the properties; City has had problems with property owners;

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☑ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☑ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☑ Trees/Wood
☐ Industrial	☐ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$7,000.00	$7,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$2,000.00	$0.00
Sanitary Sewer Service	EA	27	$1,250.00	$33,750.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	2	$7,500.00	$15,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	10	$200.00	$2,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	320	$95.00	$30,400.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$88,200.00
Soft Costs (35%)				$30,900.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$119,100.00

C.O.W. Rank: 40

By: JRH **Date:** 5/28/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-8	Brazos	Waco Creek North	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,670	832032	844062	75±	From: S 20th St To: S 16th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
15"	15"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 35 ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☑ Interference: Building, sign, etc.

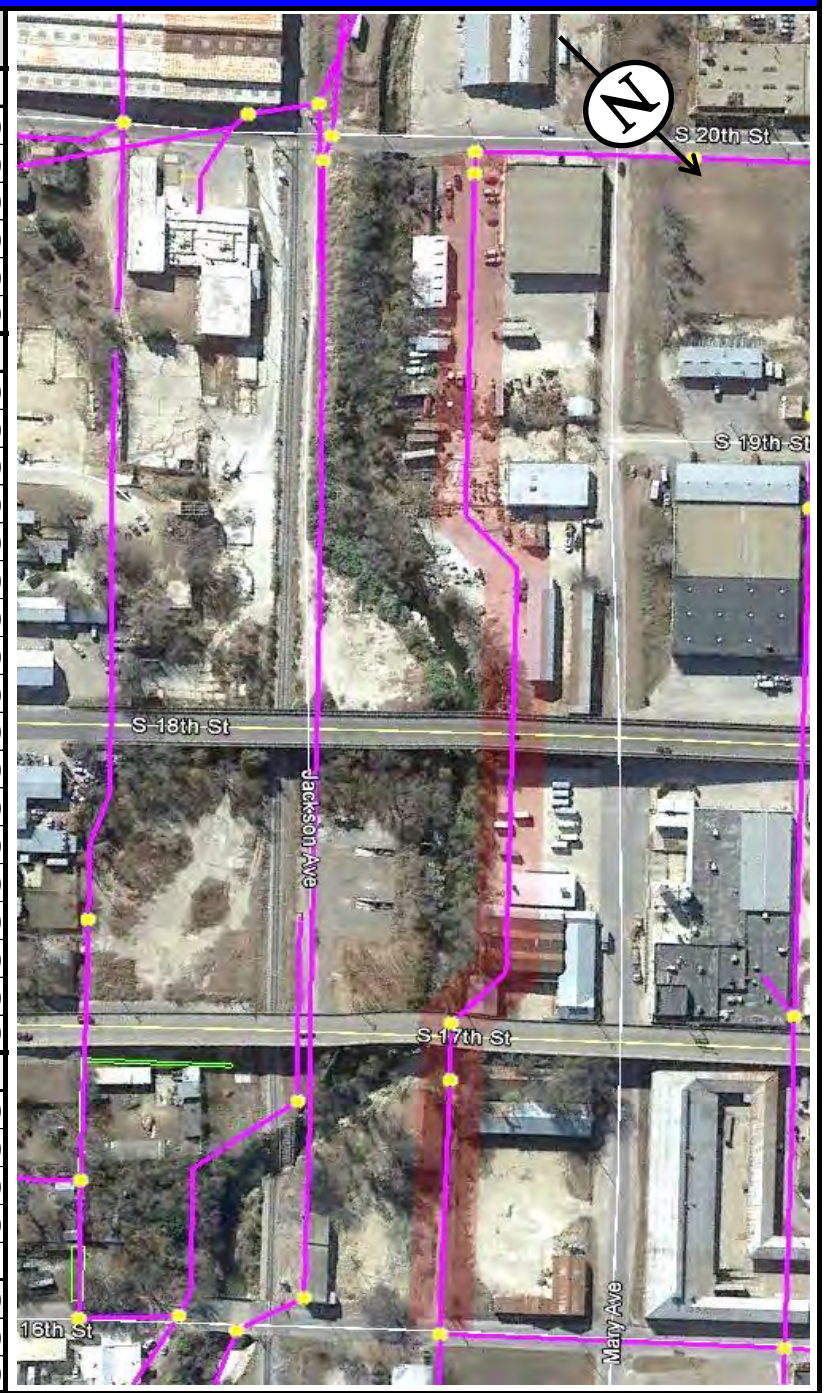
Comments

Potential reroute along Mary Ave from S 20th St to S 16th St; manhole locations don't correspond to record drawing; no easement shown on record drawings; line runs through stockyard/parking lot of multiple businesses, also under some buildings;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☑ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$23,000.00	$23,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	3	$1,250.00	$3,750.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	1650	$140.00	$231,000.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	25	$200.00	$5,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$300,300.00
Soft Costs (35%)				$105,100.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$405,400.00



C.O.W. Rank: 32 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-9	Brazos	Brazos	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,340	N/A	844011	N/A	From: S 18th St To: S 16th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6"	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 60 ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☑ Interference: Building, sign, etc.

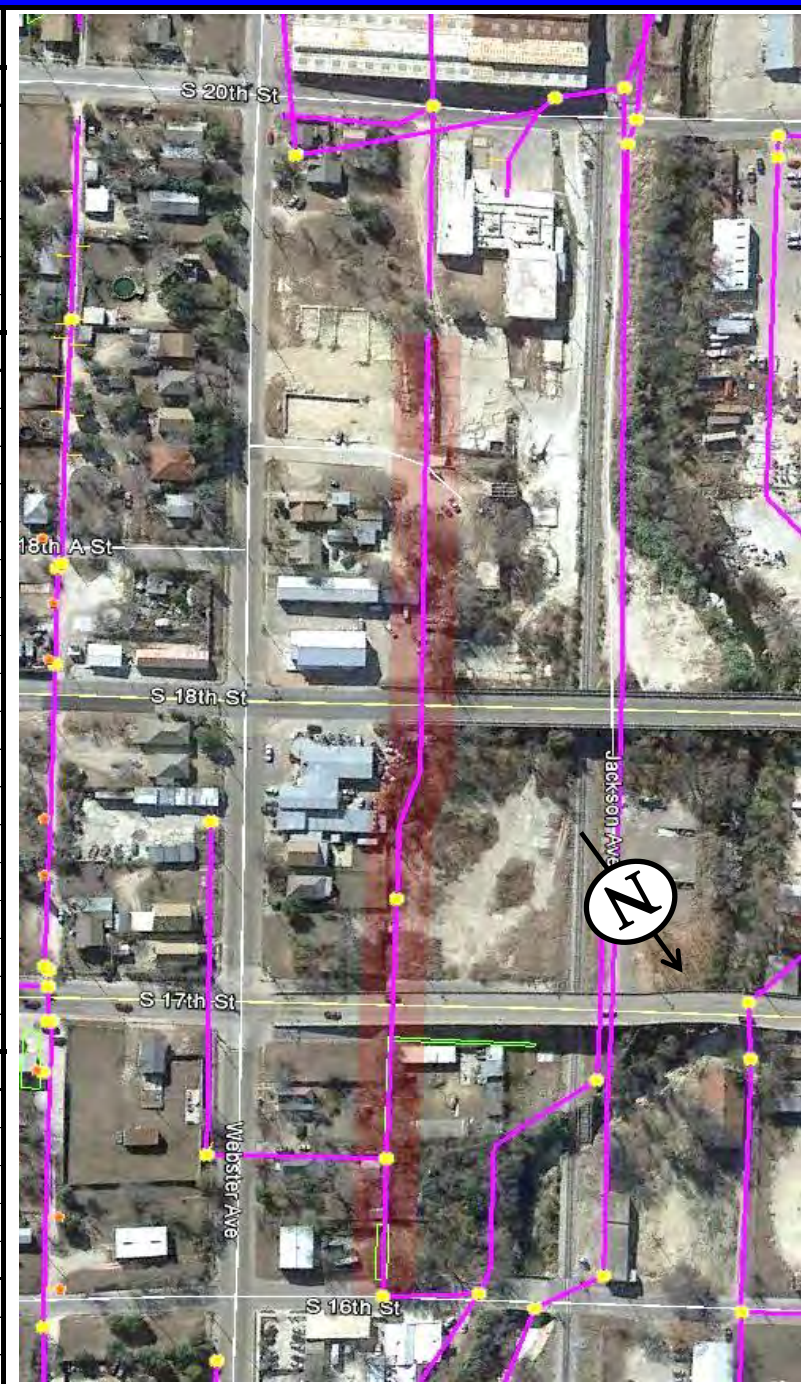
Comments

Potential reroute along Webster Ave from S 20th St to S 16th St; no record drawings; line runs through stockyard/parking lot of multiple businesses; appears to run under ramp to 18th St bridge, would need to bore; according to GIS, line was rehabed in 2003;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$15,000.00	$15,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	6	$1,250.00	$7,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	1350	$100.00	$135,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	30	$200.00	$6,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$201,000.00
Soft Costs (35%)				$70,400.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$271,400.00



C.O.W. Rank: 33 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-10	Brazos	Brazos	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,080	931072	931047	125±	From: S 18th St To: S 16th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
12" VCP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

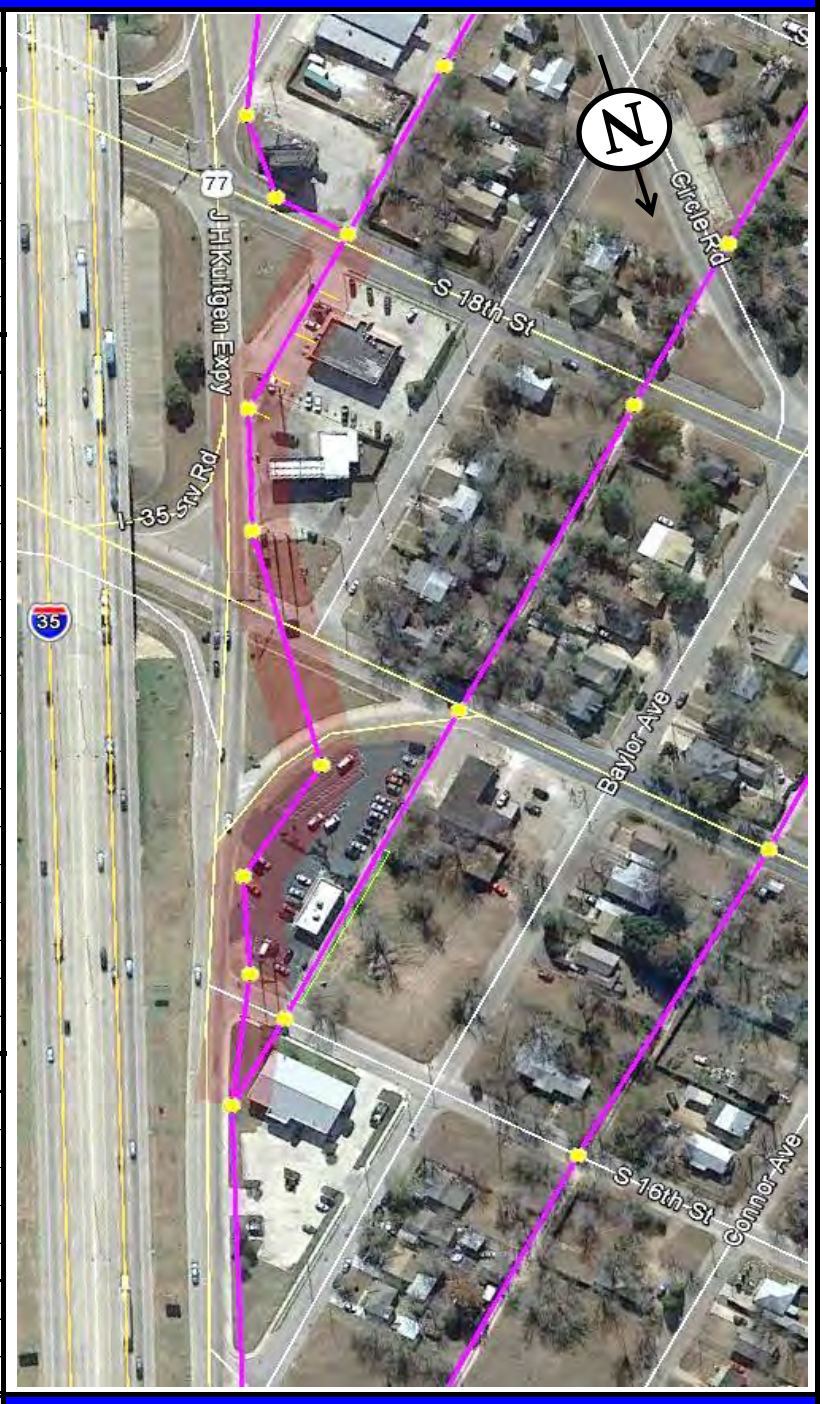
Comments

Along S Interstate 35 Access Road; line runs under multiple parking lots; potential alignment to run parallel to access road; assuming line is not in RoW;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$20,000.00	$20,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	1400	$120.00	$168,000.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	40	$200.00	$8,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$258,500.00
Soft Costs (35%)				$90,500.00
Easement Acquisition (25' Width x 1080' Length x $0.35 per square foot)				$9,500.00
Total Estimated Project Cost				$358,500.00



C.O.W. Rank: 26 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-11	Brazos	Brazos	1964

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,000	842032	842038	N/A	From: S 15th St & N I-35 Access Road To: S 12th St Overpass & N I-35 Access Road

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8" VCP	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference:
  Building, sign, etc.

Comments

Interstate 35 crossing; based on proposed Brazos Basin Interceptor, evaluation of down-sizing the lines / understading the capacity is needed; assume not in RoW

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$20,000.00	$20,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$2,000.00	$0.00
Sanitary Sewer Service	EA	4	$1,250.00	$5,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	940	$65.00	$61,100.00
8" Gravity (All Depths) - Urban	LF	60	$100.00	$6,000.00
16" Boring and Casing	LF	380	$275.00	$104,500.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	345	$120.00	$41,400.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	3	$7,500.00	$22,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	20	$200.00	$4,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$269,500.00
Soft Costs (35%)				$94,300.00
Easement Acquisition (25' Width x 3300' Length x $0.35 per square foot)				$28,900.00
Total Estimated Project Cost				$392,700.00

C.O.W. Rank: 43 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
BZ-12	Brazos	Brazos	1964, 1978

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,470	841020	941013	300±	From: South of S 10th St To: South of S 8th St & Dutton Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8" VCP	8", 12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☑ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☐ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☑ Existing Easement 15 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☑ Interference: Building, sign, etc.

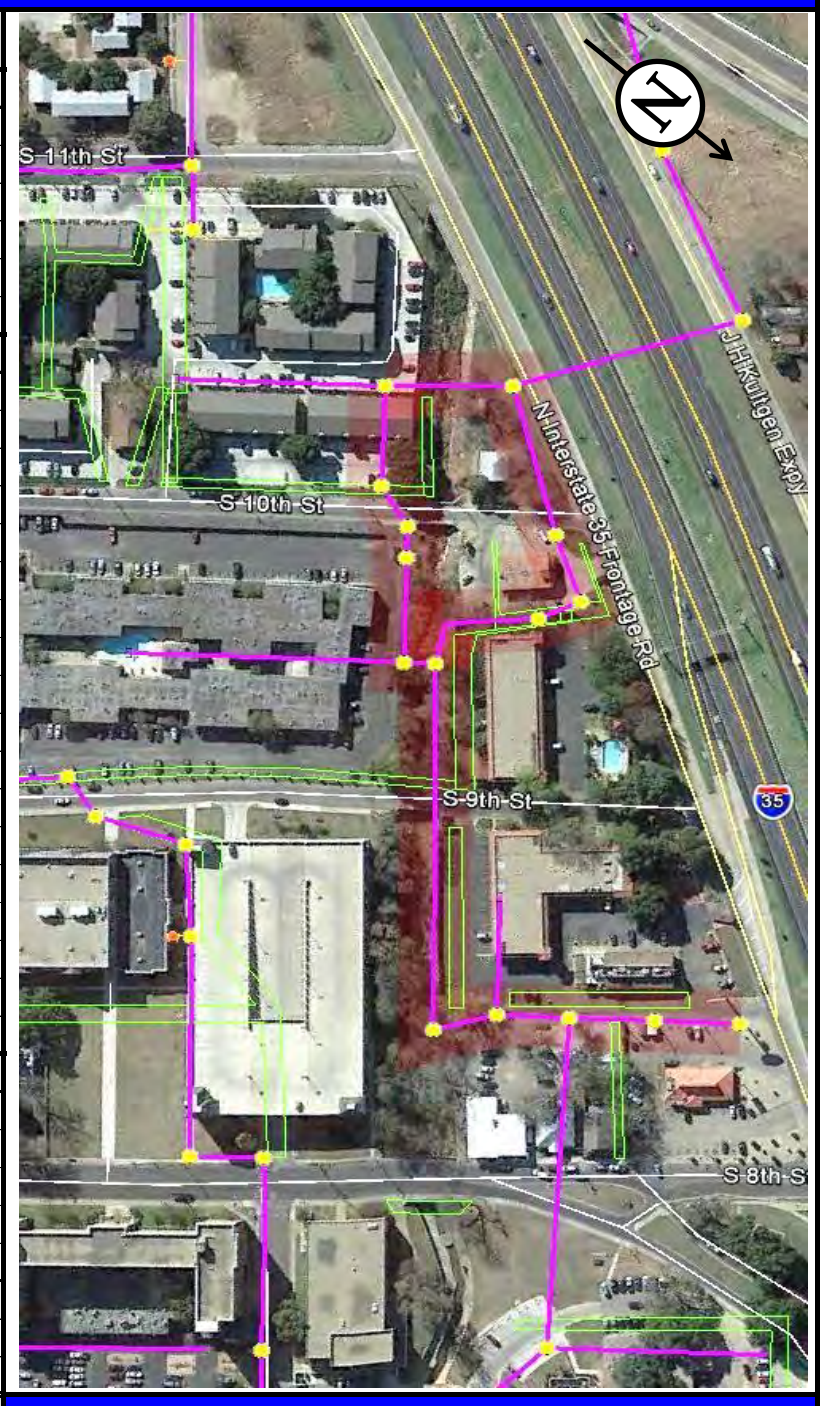
Comments

Along creek east of Interstate 35; line runs through parking lots of multiple businesses;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☑ Other: Apartments
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$26,000.00	$26,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	370	$100.00	$37,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	1100	$120.00	$132,000.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	15	$7,500.00	$112,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	90	$200.00	$18,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$346,800.00
Soft Costs (35%)				$121,400.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$468,200.00



C.O.W. Rank: 34 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CR-1	Carver	Airport	1944, 1983

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4590	321009	314001	0	From: Monkey Run Road To: Monkey Run Road

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8-10"	8", 12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☑ Interference: Building, sign, etc.

Comments

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☑ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$33,000.00	$33,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	6	$1,250.00	$7,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	2050	$65.00	$133,250.00
8" Gravity (All Depths) - Urban	LF	410	$100.00	$41,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	915	$95.00	$86,925.00
12" Gravity (All Depths) - Urban	LF	55	$120.00	$6,600.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	14	$7,500.00	$105,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	80	$200.00	$16,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$439,300.00
Soft Costs (35%)				$153,800.00
Easement Acquisition (25' Width x 4590' Length x $0.35 per square foot)				$40,200.00
Total Estimated Project Cost				$633,300.00

C.O.W. Rank: 29

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CR-2	Carver	Carver	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
				From: Lenox St (Along Dallas St)
2160	493046	494068	N/A	To: Herring Ave

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP, CIP	8"	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility	
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☐ Existing Easement	ft.	☐ Unable to Access	
☐ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☑ Existing R.O.W	60 ft.	☐ Interference:	
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.	

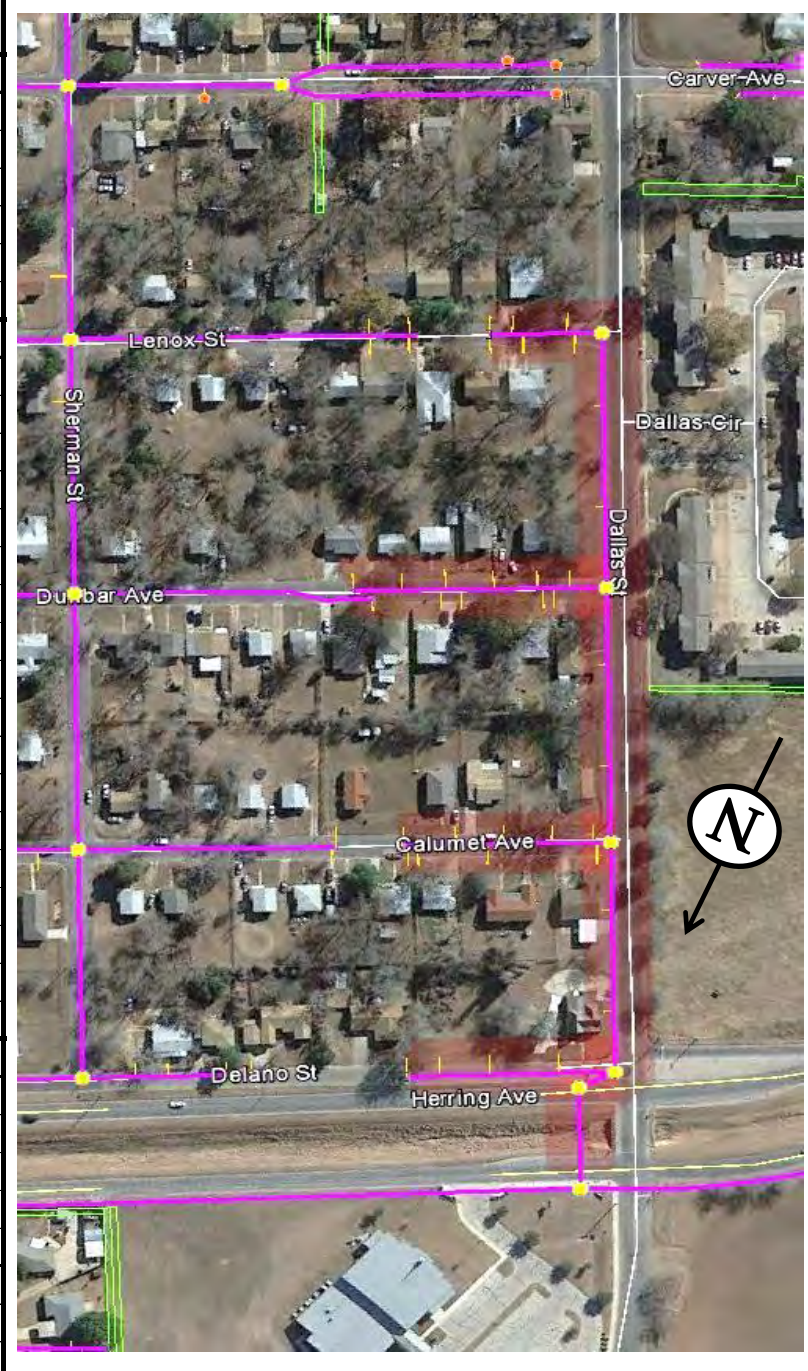
Comments

O&M problems due to flat grades; potential reroute to Carver Ave; lines within city RoW;

Land Use / Surface Cover:

☐ Rural Residential	☑ Street/Alley
☑ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☐ Trees/Wood
☐ Industrial	☐ Creek
☐ Other: _____	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$24,000.00	$24,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	20	$1,250.00	$25,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	0	$0.00
Landscape/Fence Repair	LS	1	0	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	2160	$100.00	$216,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	25	$200.00	$5,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	1	$10,500.00	$10,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	10	$275.00	$2,750.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$320,800.00
Soft Costs (35%)				$112,300.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$433,100.00



C.O.W. Rank: 7 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CR-3	Carver	Carver	1964

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
6260	494004	494009	N/A	From: Dearborn St (Along Hood St) To: Delano St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8" VCP	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 50 ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

All lines are within RoW except two, assume easements are required;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$75,000.00	$75,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	110	$1,250.00	$137,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	6260	$100.00	$626,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	20	$7,500.00	$150,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	80	$200.00	$16,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$1,009,500.00
Soft Costs (35%)				$353,300.00
Easement Acquisition (25' Width x 350' Length x $0.35 per square foot)				$3,100.00
Total Estimated Project Cost				$1,365,900.00

C.O.W. Rank: 18

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CR-4	Carver	Carver	1997

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2710	182018	271003	1000±	From: Lake Shore Dr (Along Gholson Rd) To: South of J J Flewellen Rd

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
18" PVC	18"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 20 ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

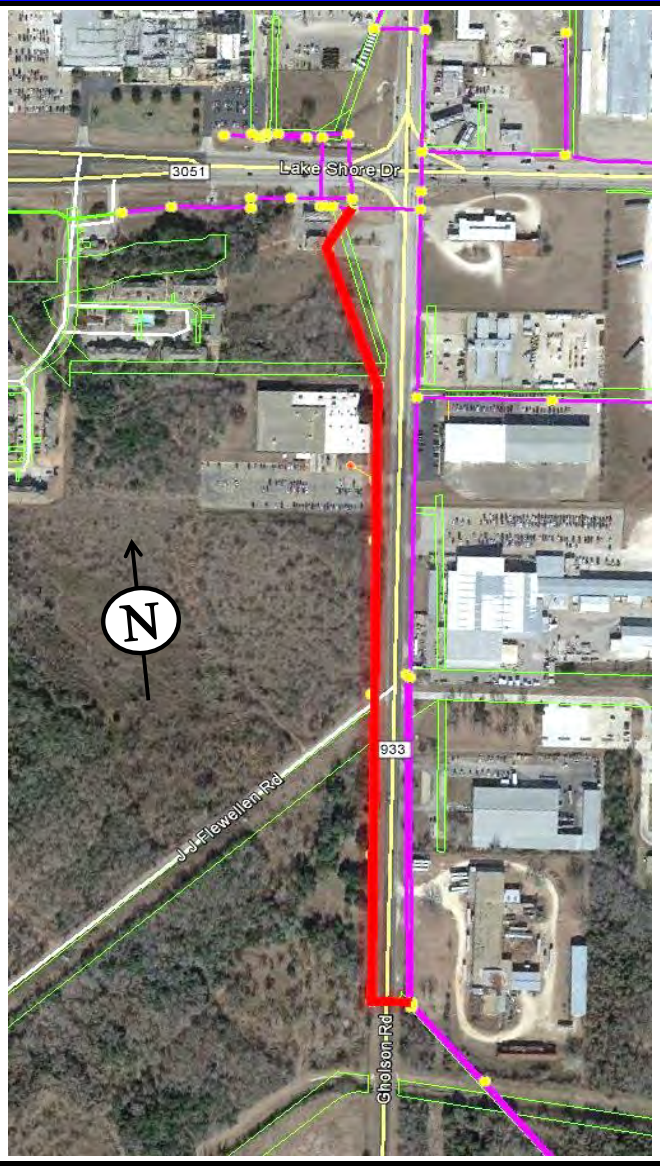
Easement shown to extend to the end of project on record drawings; assume bore under Gholson Rd.; some heavily wooded areas; no easement shown for majority of the line;

Highly Wooded Areas

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☑ Industrial
- ☐ Other: _____
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$50,000.00	$50,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	4	$4,000.00	$16,000.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	2710	$150.00	$406,500.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	80	$525.00	$42,000.00
6' Diameter Concrete Manhole	EA	10	$10,500.00	$105,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	50	$275.00	$13,750.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$665,800.00
Soft Costs (35%)				$233,000.00
Easement Acquisition (25' Width x 2020' Length x $0.35 per square foot)				$17,700.00
Total Estimated Project Cost				$916,500.00



C.O.W. Rank: 47 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-1	Cottonwood	Cottonwood	1970

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,240	1033005	1184018	750±	From: Owen Ln To: N St Hwy 6 Access Road

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10" VCP	8", 12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 45 ft.
- ☐ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

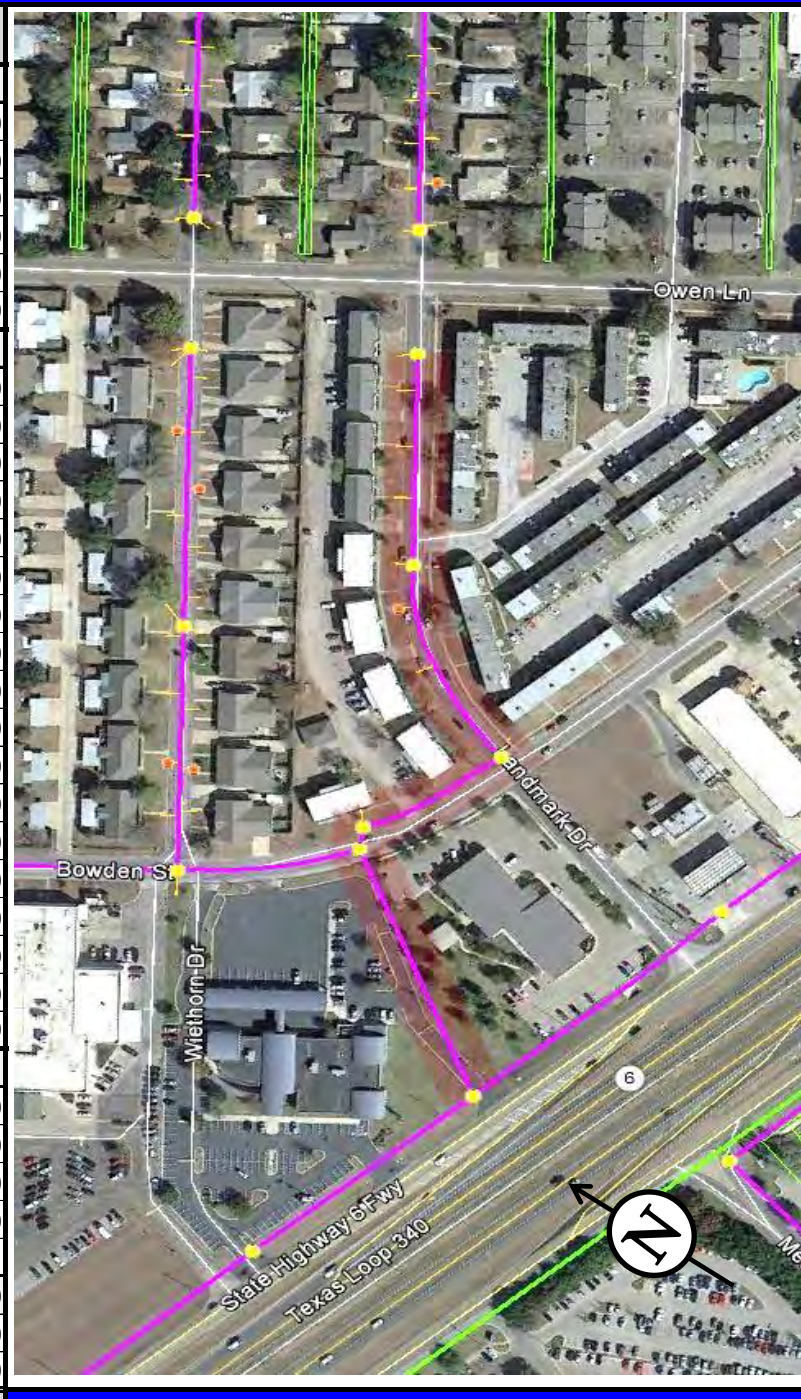
Comments

6-8" will be replaced with 8", 10" will be replaced with 12"; assumed 40 services per apartment building for connection at manhole on corner of Landmark and Bowden; assuming that all pipe is within RoW except that from Bowden to Hwy 6 Access Rd;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☑ Other: Apartments
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$17,000.00	$17,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	10	$1,250.00	$12,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	850	$100.00	$85,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	390	$120.00	$46,800.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	10	$200.00	$2,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$228,300.00
Soft Costs (35%)				$79,900.00
Easement Acquisition (25' Width x 380' Length x $0.35 per square foot)				$3,400.00
Total Estimated Project Cost				$311,600.00



C.O.W. Rank: 28

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-2	Cottonwood	Upper Cottonwood	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,850	1033002	1032025	200±	From: East of Owen Ln To: Richland Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6"	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	10 ft.	☐ Unable to Access
☐ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☑ Interference:
☐ Other: _____		☑ Requires Easement	25 ft.	Building, sign, etc.

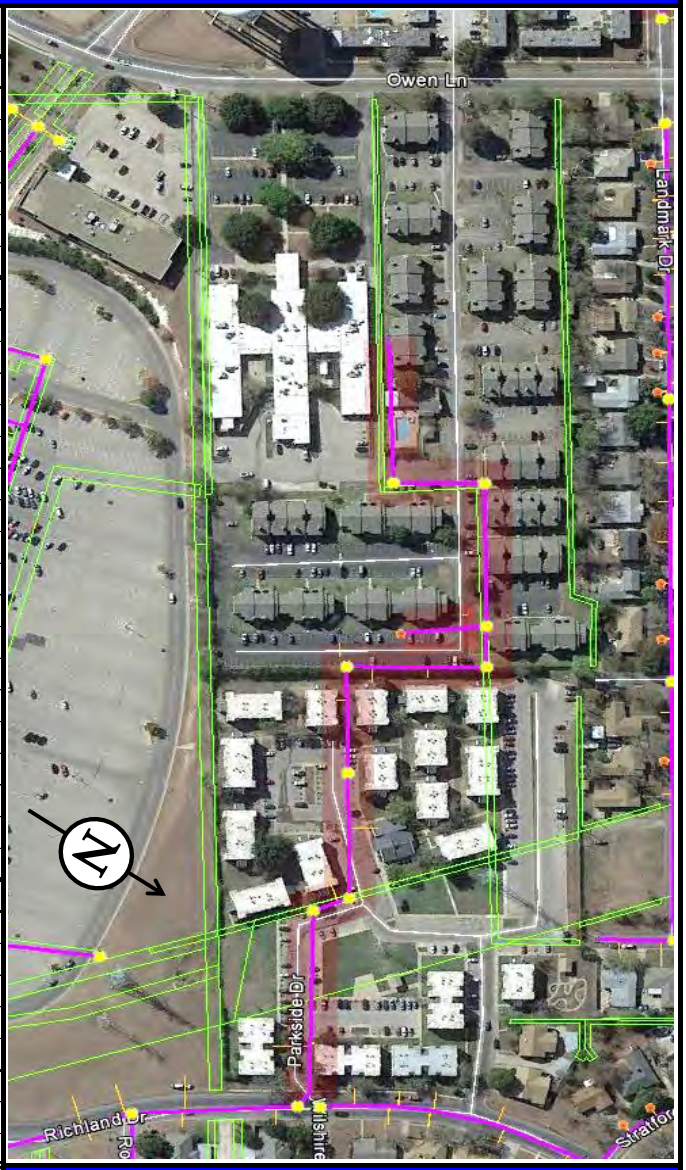
Comments

Line runs through/under multiple apartment complexes; no record drawings or as-builts; assuming no easement for the downstream apartments

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☐ Single Family Residential	☑ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☐ Trees/Wood
☐ Industrial	☐ Creek
☑ Other: Apartments	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$23,000.00	$23,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	2	$300.00	$600.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	1850	$95.00	$175,750.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$299,400.00
Soft Costs (35%)				$104,800.00
Easement Acquisition (25' Width x 1020' Length x $0.35 per square foot)				$9,000.00
Total Estimated Project Cost				$413,200.00



C.O.W. Rank: 35

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-3	Cottonwood	Upper Cottonwood	1956, 1991

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4,670	961029	1044060	1200±	From: Bosque Blvd To: Sanger Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
12"-18"	15", 21"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	10 ft.	☐ Unable to Access
☑ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☑ Existing R.O.W	ft.	☐ Interference:
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.

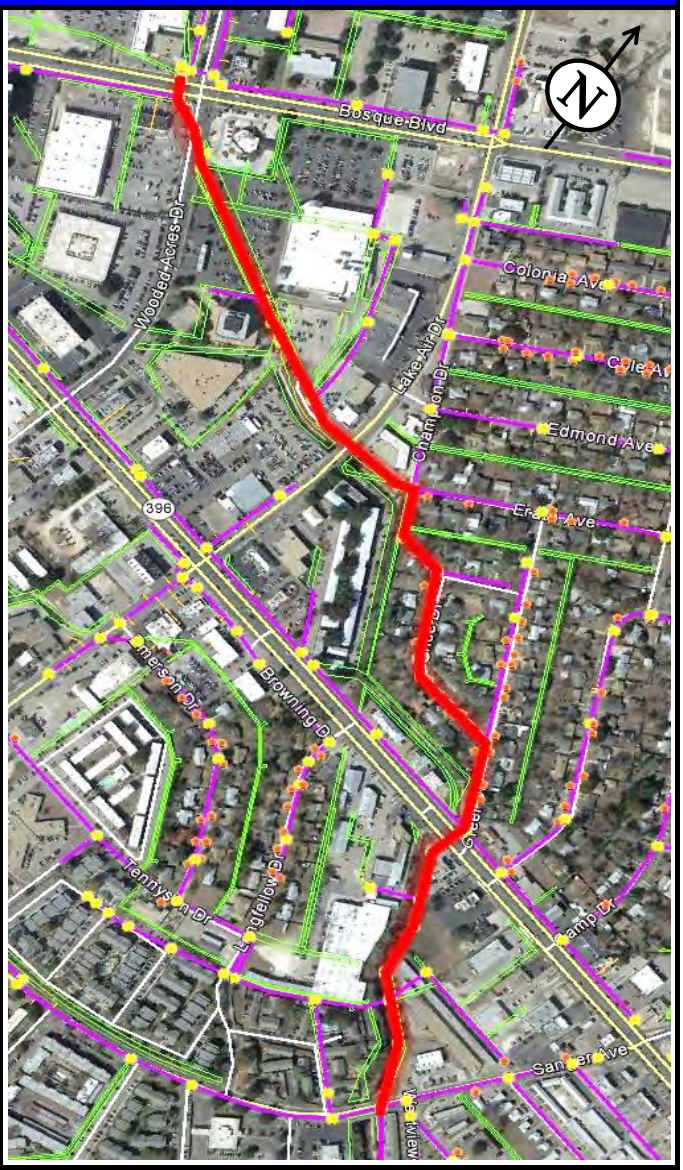
Comments

Sewer line along Greer Dr replaced with 12" PVC in 1991; **Possible siphon east of Wells Fargo where sewer crosses storm drain**; sewere runs beneath parking lots of multiple business or under road; parallels drainage;

Land Use / Surface Cover:

☐ Rural Residential	☑ Street/Alley
☑ Single Family Residential	☑ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☑ Commercial	☐ Trees/Wood
☐ Industrial	☑ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$91,000.00	$91,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	25	$1,250.00	$31,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$25,000.00	$25,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	20	$7,500.00	$150,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	40	$200.00	$8,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	1170	$175.00	$204,750.00
21" Gravity (All Depths) - Urban	LF	30	$190.00	$5,700.00
30" Boring and Casing	LF	150	$525.00	$78,750.00
6' Diameter Concrete Manhole	EA	10	$10,500.00	$105,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	40	$275.00	$11,000.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	3470	$140.00	$485,800.00
Construction Subtotal				$1,221,300.00
Soft Costs (35%)				$427,500.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,648,800.00



C.O.W. Rank: 4

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-4	Cottonwood	Upper Cottonwood	1964, 1968

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,670	1181007	1174011	300±	From: Southeast corner of Richland Mall To: Railroad Tracks

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
10" CIP, VCP	12"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	20 ft.	☐ Unable to Access
☐ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.

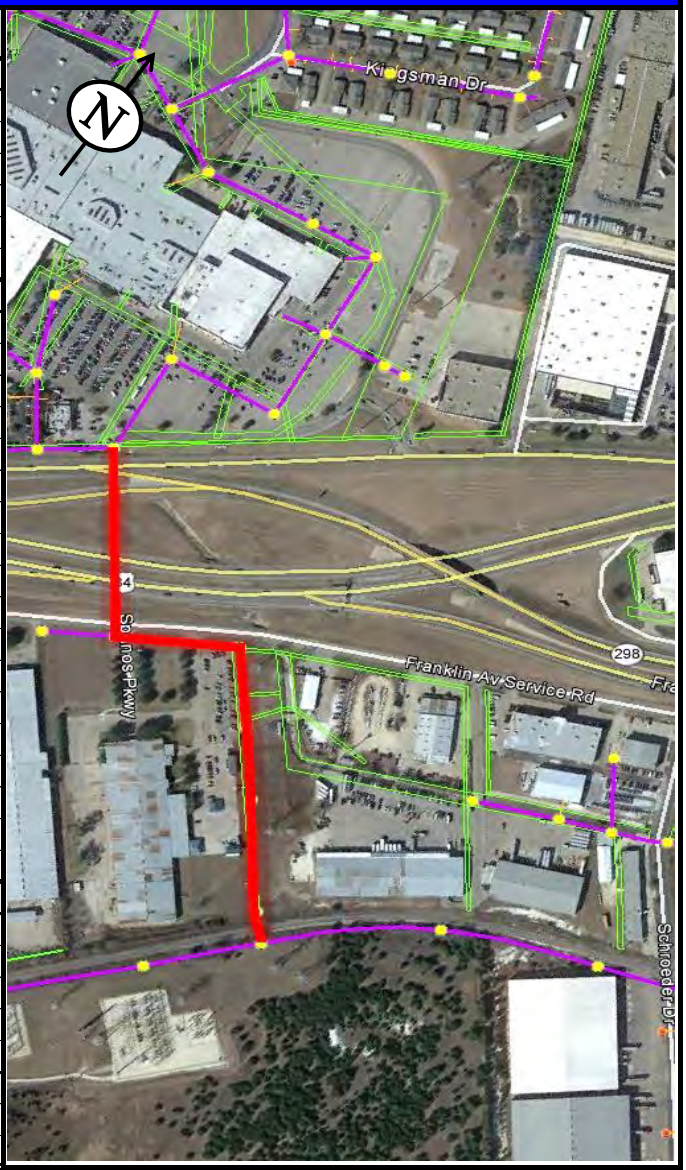
Comments

US Hwy 84 crossing; condition of casing pipe needs to be field verified; assumed casing pipe needs replacement; assumed bore entire length under Hwy 84; easement on section of pipe from access road to railroad tracks; bore and encase under railroad;

Land Use / Surface Cover:

☐ Rural Residential	☑ Street/Alley
☐ Single Family Residential	☐ Parking Lot
☑ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☑ Field
☑ Commercial	☐ Trees/Wood
☐ Industrial	☑ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$35,000.00	$35,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	1610	$95.00	$152,950.00
12" Gravity (All Depths) - Urban	LF	60	$120.00	$7,200.00
18" Boring and Casing	LF	500	$325.00	$162,500.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$462,200.00
Soft Costs (35%)				$161,800.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$624,000.00



C.O.W. Rank: 21

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-5	Cottonwood	Upper Cottonwood	1961

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4,230	1174016	1042013	3000±	From: East of Schroeder Dr To: S New Rd Overpass over Railroad Track

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
15-24" VCP	18", 24"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☐ Existing Easement ft.		☐ Unable to Access
☐ Inadequate Hydraulic Capacity	☑ Aerial Crossing(s)	☐ Existing R.O.W ft.		☐ Interference:
☐ Other: _____		☑ Requires Easement 25 ft.		Building, sign, etc.

Comments

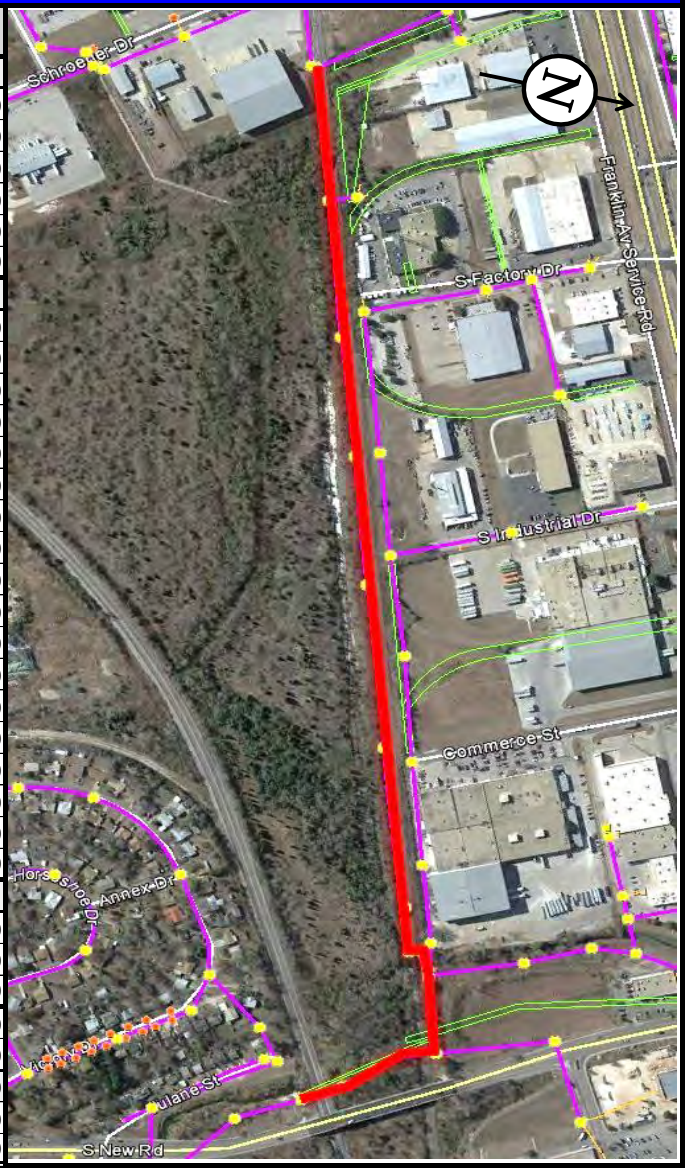
Sewer line parallels railroad tracks; aerial crossing at east end of project, possible aerial near beginning of project; heavily wooded area, difficult to access, unable to locate manholes; no easement shown on GIS or record drawings; bore and encase under each railroad crossing (3)

Highly Wooded Area

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☐ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☑ Field
☐ Commercial	☑ Trees/Wood
☑ Industrial	☐ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$88,000.00	$88,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	42.5	$4,000.00	$170,000.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	50	$300.00	$15,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	3440	$150.00	$516,000.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	50	$525.00	$26,250.00
6' Diameter Concrete Manhole	EA	15	$10,500.00	$157,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	100	$275.00	$27,500.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
24" Gravity (All Depths) - Rural	LF	790	$200.00	$158,000.00
36" Boring and Casing	LF	250	$650.00	$162,500.00
Construction Subtotal				$1,345,800.00
Soft Costs (35%)				$471,000.00
Easement Acquisition (25' Width x 4230' Length x $0.35 per square foot)				$37,100.00
Total Estimated Project Cost				$1,853,900.00



C.O.W. Rank: 42 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
CW-6	Cottonwood	Upper Cottonwood	1954

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
310	1041045	1042027	2500±	From: West side of Franklin Ave and N New Rd To: South side of Franklin Ave and S New Rd

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
18" VCP	21"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☐ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☑ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

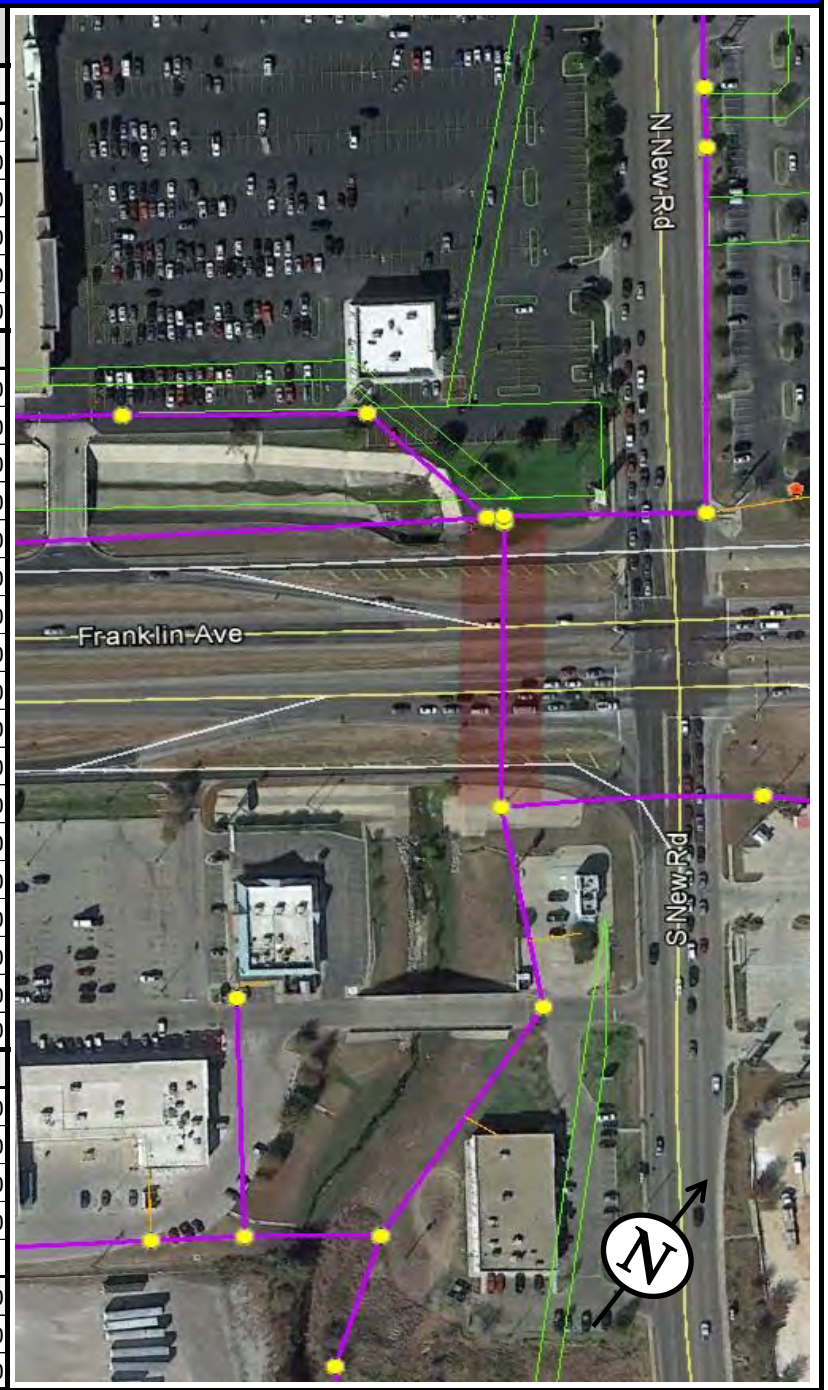
Comments

Franklin Ave crossing; verify condition of encasing pipe; assumed new casing pipe needed; in TxDOT RoW;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☑ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$22,000.00	$22,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	310	$175.00	$54,250.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	310	$525.00	$162,750.00
6' Diameter Concrete Manhole	EA	2	$10,500.00	$21,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	20	$275.00	$5,500.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$290,500.00
Soft Costs (35%)				$101,700.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$392,200.00



C.O.W. Rank: 38

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
FC-1	Flat Creek	Panther Way	1980, 1984

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,170	1463071	1463092	750±	From: Chapel Rd To: Reno Dr at drainage ditch crossing

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6",8"	8"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 50 ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference:
  Building, sign, etc.

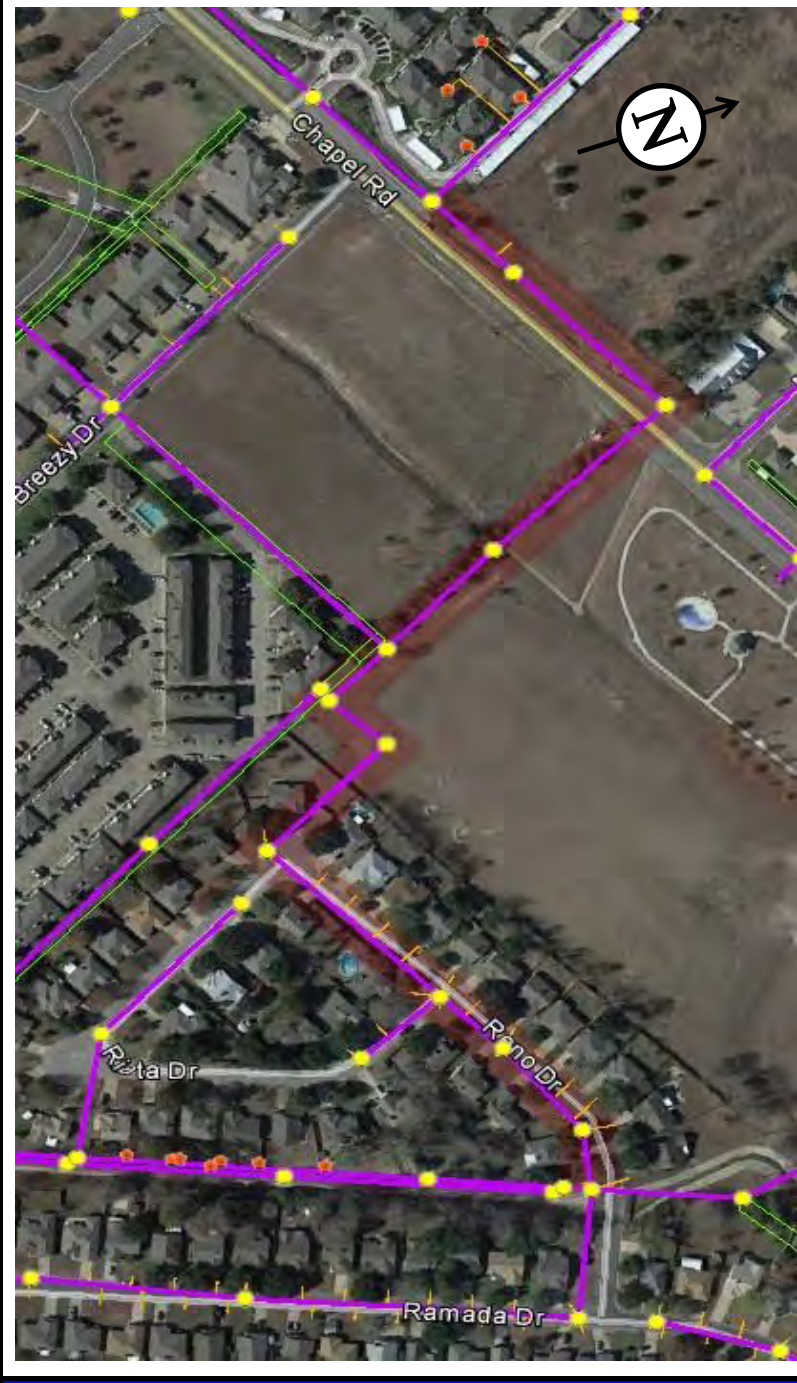
Comments

Overflowing manhole upstream of Woodgate Intermediate School; assume bore and encase under Chapel Rd; easement needed for line in open area between Chapel Rd and Reno Dr;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☑ Street/Alley
- ☐ Parking Lot
- ☑ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$28,000.00	$28,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	20	$1,250.00	$25,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$20,000.00	$20,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	1440	$65.00	$93,600.00
8" Gravity (All Depths) - Urban	LF	730	$100.00	$73,000.00
16" Boring and Casing	LF	90	$275.00	$24,750.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	12	$7,500.00	$90,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$376,400.00
Soft Costs (35%)				$131,700.00
Easement Acquisition (25' Width x 900' Length x $0.35 per square foot)				$7,900.00
Total Estimated Project Cost				$516,000.00



C.O.W. Rank: 22

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
FC-2	Flat Creek	Panther Way	2008

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,590	1464260	1461066	2000±	From: East of Woodgate Dr To: Hewitt Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
18"	21"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☐ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☑ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 20 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

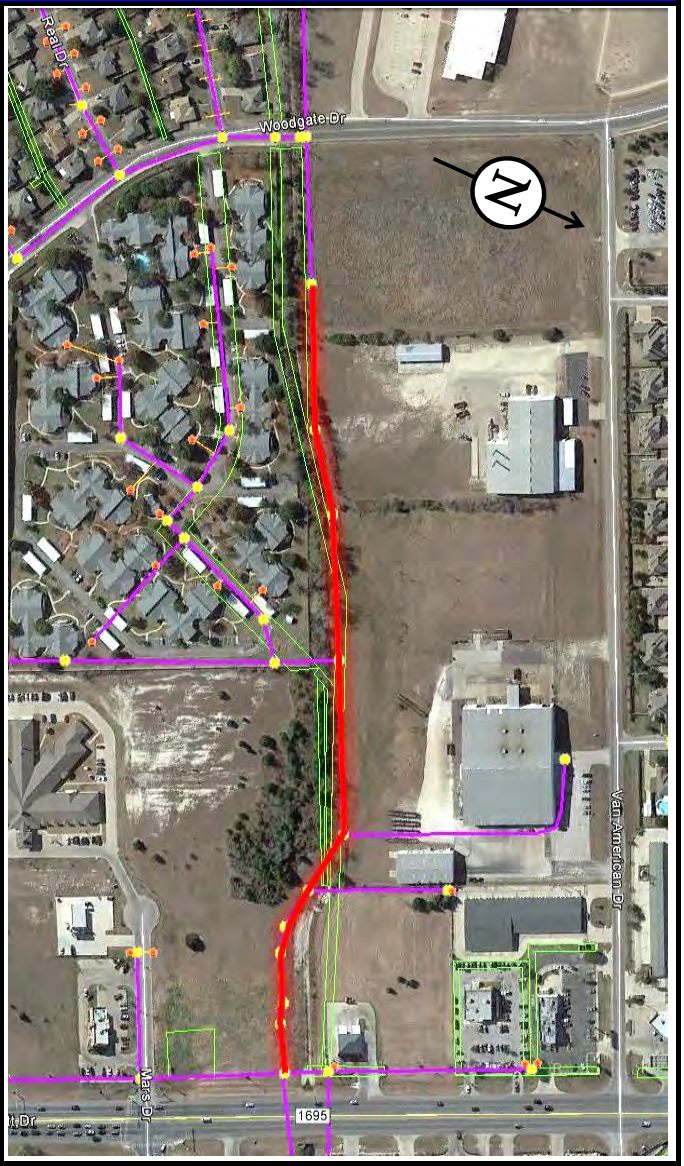
Comments

Reroute of Church Road Lift Station flows may eliminate problem; potentially low priority; no record drawings; line was rehabed in 2008 by Knife River; runs parallel to creek;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$38,000.00	$38,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	1	$1,250.00	$1,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	1590	$175.00	$278,250.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	12	$10,500.00	$126,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	100	$275.00	$27,500.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$501,000.00
Soft Costs (35%)				$175,400.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$676,400.00



C.O.W. Rank: 51

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
FC-3	Flat Creek	Flat Creek	1975

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
6,340	1471007	1484002	4250±	From: East of End of Panther Way To: Bagby Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
12", 21"-24" VCP	12", 21", 24"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☐ Existing Easement	ft.	☐ Unable to Access
☑ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:
☐ Other: _____		☑ Requires Easement	25 ft.	Building, sign, etc.

Comments

South Flat Creek sewer line; some heavily wooded areas, difficult to access; capacity issues may be resolved by Church Rd Lift Station reroute; bid quantities reflect no needed increase in capacity;

Highly Wooded Areas

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☐ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☑ Parks/Open Space	☑ Field
☐ Commercial	☑ Trees/Wood
☐ Industrial	☑ Creek
☐ Other: _____	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$71,000.00	$71,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	15	$4,000.00	$60,000.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	790	$95.00	$75,050.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	5	$7,500.00	$37,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	40	$200.00	$8,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	2730	$175.00	$477,750.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	16	$10,500.00	$168,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	120	$275.00	$33,000.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
24" Gravity (All Depths) - Rural	LF	2820	$200.00	$564,000.00
36" Boring and Casing	LF	110	$625.00	$68,750.00
Construction Subtotal				$1,588,100.00
Soft Costs (35%)				$555,800.00
Easement Acquisition (25' Width x 6340 Length x $0.35 per square foot)				$55,500.00
Total Estimated Project Cost				$2,199,400.00

C.O.W. Rank: 9 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
MLK-1	MLK	West MLK	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
				From: Mrytle St
300	633055	633003	750±	To: West of Union Pacific Railroad

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
15" VCP	15"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

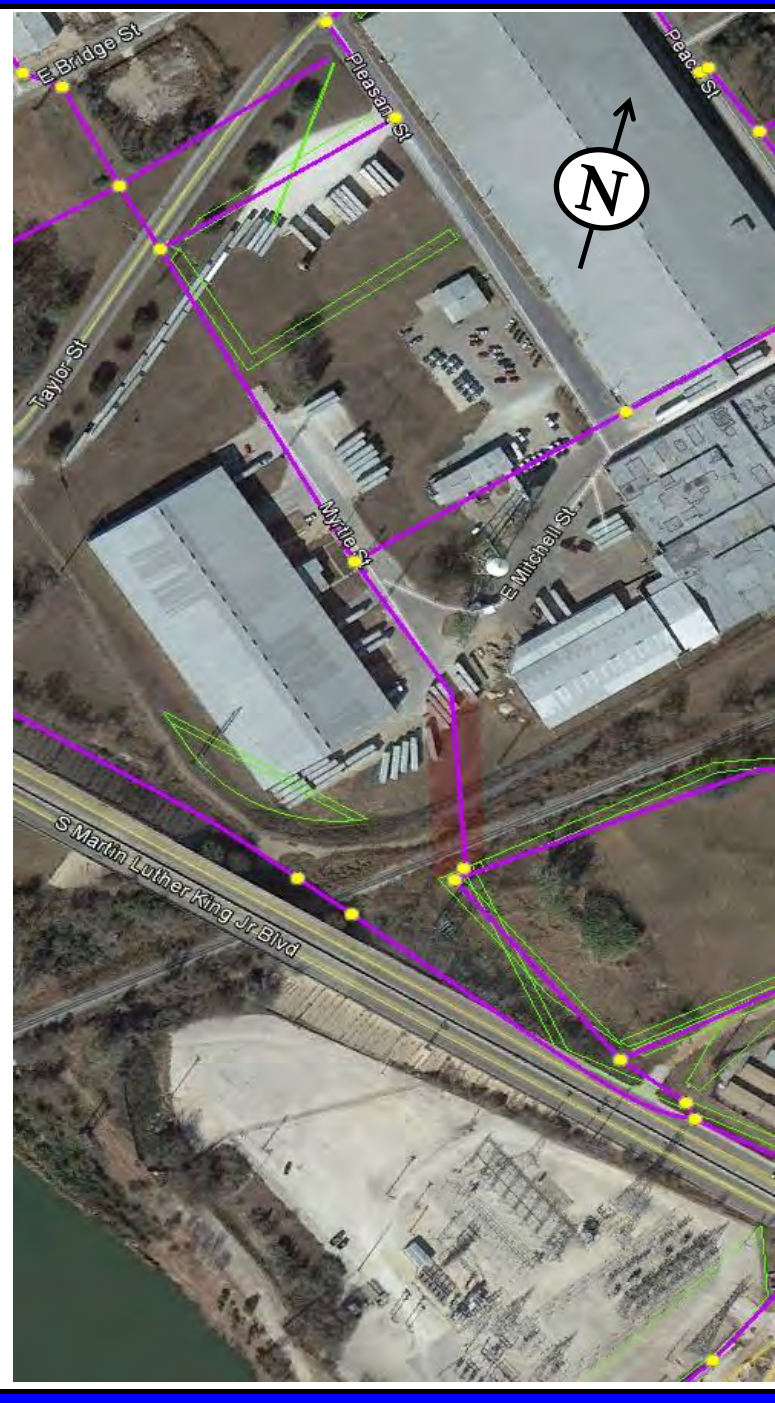
Comments

Beginning manhole rehabed in 2005; ending manhole was installed new in 2010 as part of sanitary sewer improvements downstream of problem area; only portion of the sewere line in the open area, not under pavement; assumed bore and encase under railroad track;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☑ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$9,000.00	$9,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	1	$1,250.00	$1,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	300	$125.00	$37,500.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	70	$425.00	$29,750.00
4' Diameter Concrete Manhole	EA	2	$7,500.00	$15,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	30	$200.00	$6,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$113,500.00
Soft Costs (35%)				$39,700.00
Easement Acquisition (25' Width x 300' Length x $0.35 per square foot)				$2,700.00
Total Estimated Project Cost				$155,900.00



C.O.W. Rank: 31

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
MLK-2	MLK	West MLK	1958

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
980	402017	491032	150±	From: Calumet Ave and Cantrell St To: West of Seley Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
10" VCP	12"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

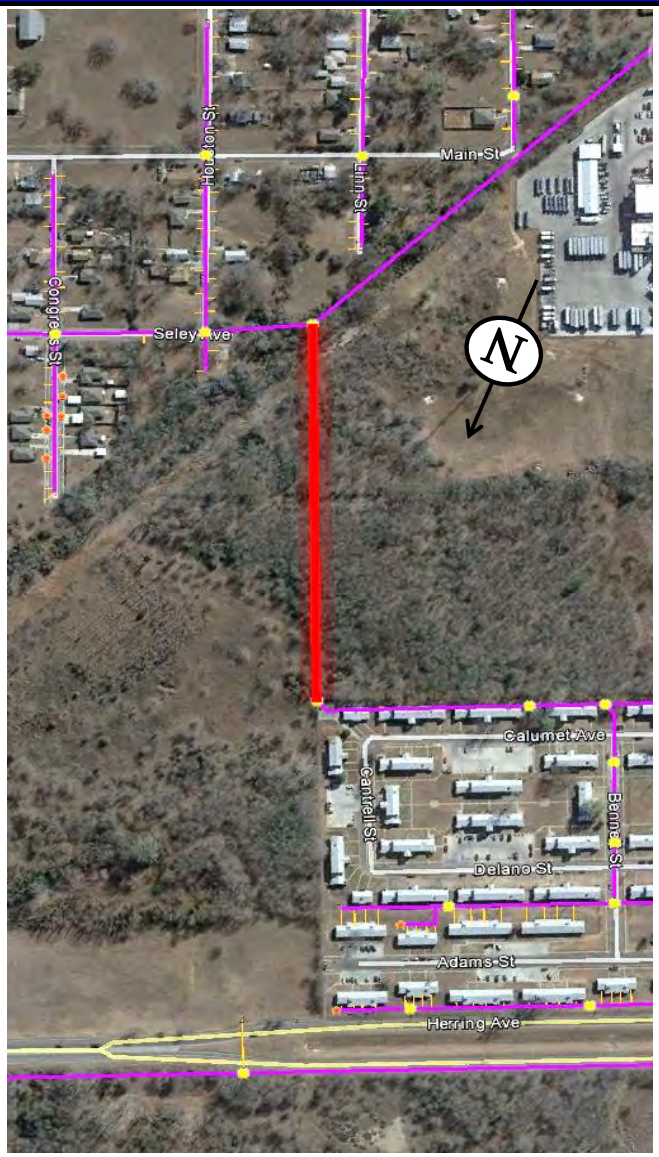
Upstream sewer lines owned by Waco Housing Authority; heavily wooded area, difficult to access; no easement shown on drawings;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☑ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☑ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$14,000.00	$14,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	10	$4,000.00	$40,000.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	980	$95.00	$93,100.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	3	$7,500.00	$22,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	20	$200.00	$4,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$183,600.00
Soft Costs (35%)				$64,300.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$8,600.00
Total Estimated Project Cost				$256,500.00



C.O.W. Rank: 17

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
MLK-3	MLK	East MLK	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
7120	N/A	N/A	N/A	From: Loop 340 (Timbercrest Addition) To: Crow Dr (small portion of Berkshire St)

CITY OF WACO

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8"	8"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	15 ft.	☑ Unable to Access
☐ Inadequate Hydraulic Capacity	☐ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.

Comments

Some lines located in the rear of lots; potential pipe bursting project; heavily wooded area, difficult to access; section of pipe along Crow between Kendall and Idylwood was installed as PVC in 1992;

Highly Wooded Area

Land Use / Surface Cover:

☑ Rural Residential	☑ Street/Alley
☐ Single Family Residential	☐ Parking Lot
☑ Public/Semi-Public	☑ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☑ Trees/Wood
☐ Industrial	☐ Creek
☐ Other: _____	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$83,000.00	$83,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	125	$1,250.00	$156,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	1755	$100.00	$175,500.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	20	$7,500.00	$150,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	150	$200.00	$30,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	5365	$95.00	$509,675.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$1,114,400.00
Soft Costs (35%)				$390,000.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,504,400.00

C.O.W. Rank: 8

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
MLK-4	MLK	TSTC	1991

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
9550	2242003	11006	2000±	From: Int. of Maehr and Concord Rd To: St Hwy 31 / TSTC Lift Station

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
18-24" PVC	21", 24"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☑ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☐ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☐ Existing R.O.W ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference:
  Building, sign, etc.

Comments

Small percentage along Concord Rd; upsize 18" to 21", 21" to 24"; easements shown on record drawings, not on GIS; assumed no easement; assumed bore and encase under Aviation Pkwy

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$174,000	$174,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	1	$1,250.00	$1,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	4020	$175.00	$703,500.00
21" Gravity (All Depths) - Urban	LF	1500	$190.00	$285,000.00
30" Boring and Casing	LF	65	$525.00	$34,125.00
6' Diameter Concrete Manhole	EA	25	$10,500.00	$262,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	150	$275.00	$41,250.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
24" Gravity (All Depths) -Rural	LF	4030	$200.00	$806,000.00
Construction Subtotal				$2,342,600.00
Soft Costs (35%)				$819,900.00
Easement Acquisition (25' Width x 9550' Length x $0.35 per square foot)				$83,600.00
Total Estimated Project Cost				$3,246,100.00

C.O.W. Rank: 46

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
PR-1	Primrose	West Primrose	1954

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4,530	933114	1061029	750±	From: Dutton Ave (along S 26th St) To: La Salle Ave

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
10"	12"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☑ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 35-60 ft.
- ☑ Existing R.O.W 60 ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Interstate 35 crossing; majority of line under pavement, assumed potential pipe bursting project; assumed bore and encase under I-35; new 12" will replace both 10" and 6" lines on 26th from Speight to Bagby; easement needed for end of the line between Circle Rd and LaSalle;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$74,000.00	$74,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	50	$1,250.00	$62,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	560	$95.00	$53,200.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	560	$325.00	$182,000.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	3970	$130.00	$516,100.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$987,800.00
Soft Costs (35%)				$345,700.00
Easement Acquisition (25' Width x 240 'Length x $0.35 per square foot)				$2,100.00
Total Estimated Project Cost				$1,335,600.00

C.O.W. Rank: 61 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
PR-2	Primrose	Primrose	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
5,210	1061029	924021	900±	From: S 25th St (along La Salle Ave) To: S 12th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
15"	18"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☑ Inadequate Hydraulic Capacity
- ☐ Other: _____
- ☐ Fat, Oil, and Grease
- ☐ Aerial Crossing(s)

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 150 ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

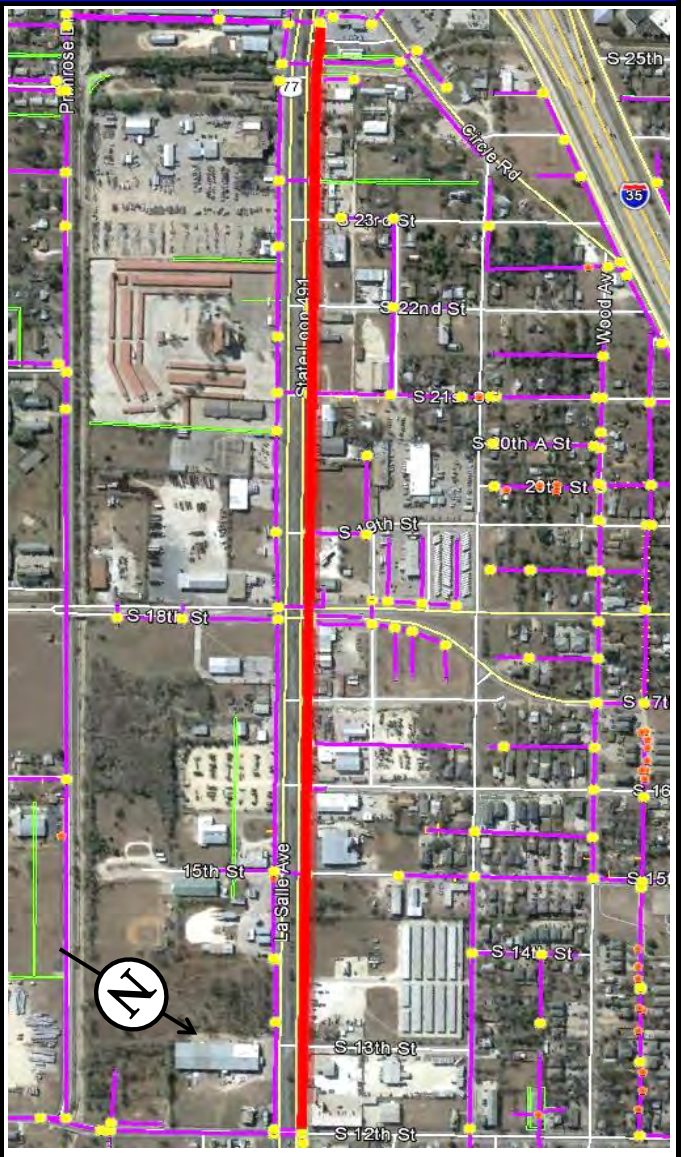
Comments

Sewer line on the north side of La Salle Ave; line under the edge of pavement, assumed open trench along shoulder of road;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☑ Parking Lot
- ☐ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$85,000.00	$85,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	15	$1,250.00	$18,750.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$15,000.00	$15,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	5210	$165.00	$859,650.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	12	$10,500.00	$126,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	100	$275.00	$27,500.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$1,141,900.00
Soft Costs (35%)				$399,700.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,541,600.00



C.O.W. Rank: 5 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
PR-3	Primrose	Primrose	1954

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
4,850	1061005	924009	3200±	From: S 24th St (along Primrose Dr) To: S 12th St

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
21"	24"	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☑ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 60 ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

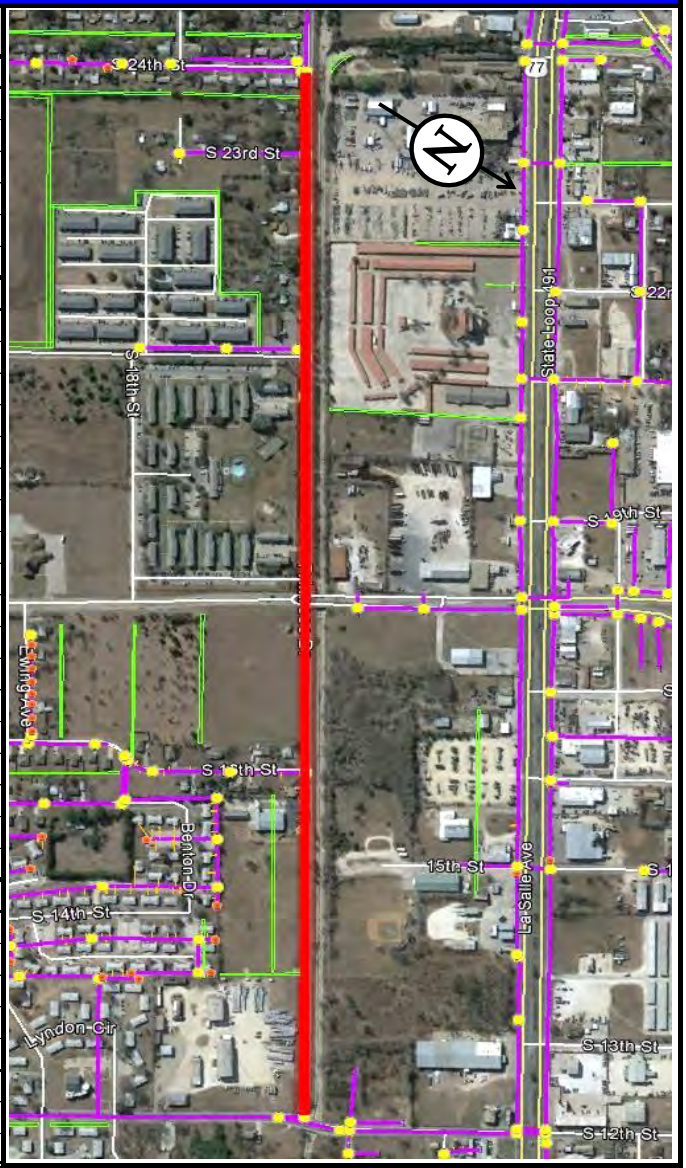
Comments

Sewer line in the middle of Primrose; assumed potential for pipe bursting;

Land Use / Surface Cover:

☐ Rural Residential	☑ Street/Alley
☑ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☐ Trees/Wood
☐ Industrial	☐ Creek
☐ Other:	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$84,000.00	$84,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	10	$1,250.00	$12,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	10	$10,500.00	$105,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	70	$275.00	$19,250.00
Trenchless				
8" Pipe Bursting	LF	0	$95.00	$0.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
24" Pipe Bursting	LF	4850	$180.00	$873,000.00
Construction Subtotal				$1,128,800.00
Soft Costs (35%)				$395,100.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,523,900.00



C.O.W. Rank: 25

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
PR-4	Primrose	South Primrose	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,330	N/A	1152061	75±	From: East of Waverly St To: US Hwy 77

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 10 ft.
- ☑ Existing R.O.W 50 ft.
- ☐ Requires Easement ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Sewer lines along and between Ferndale Dr, Clover Leaf Dr, and Wynmore Dr; small portion of lines cut through yards, assumed pipe bursting for these sections of pipe; easements may be needed on the south section of line from Ferndale to Clover Leaf and north section of the line from Clover Leaf to Wynmore; sections between streets rehabed in 1987 with PVC;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☑ Yard
- ☐ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$31,000.00	$31,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	50	$1,250.00	$62,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	1780	$100.00	$178,000.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	550	$95.00	$52,250.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$408,800.00
Soft Costs (35%)				$143,100.00
Easement Acquisition (25' Width x 175' Length x $0.35 per square foot)				$1,600.00
Total Estimated Project Cost				$553,500.00

C.O.W. Rank: 50

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
PR-5	Primrose	Primrose	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
3,050	863011	864001	5000±	From: 1st St (along Gurley Ln) To: Transfer LS

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
36"	36"	☑ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☐ Existing Easement ft.
- ☑ Existing R.O.W 45 ft.
- ☑ Requires Easement 25 ft.

Accessibility

- ☐ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Sewer line runs under Gurley Ln, assumed open trench; assumed bore and encase under University Parks;

Land Use / Surface Cover:

- ☐ Rural Residential
- ☐ Single Family Residential
- ☐ Public/Semi-Public
- ☑ Parks/Open Space
- ☑ Commercial
- ☐ Industrial
- ☐ Other:
- ☑ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☑ Field
- ☐ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$54,000.00	$54,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	2	$1,250.00	$2,500.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS			$0.00
Landscape/Fence Repair	LS			$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	0	$7,500.00	$0.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	0	$200.00	$0.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	10	$10,500.00	$105,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	80	$275.00	$22,000.00
Trenchless				
8" Pipe Bursting	LF		$95.00	$0.00
10" Pipe Bursting	LF		$115.00	$0.00
36" Gravity (All Depths) - Rural	LF	2090	$260.00	$543,400.00
36" Gravity (All Depths) - Urban	LF	960	$275.00	$264,000.00
48" Boring and Casing	LF	120	$700.00	$84,000.00
Construction Subtotal				$1,074,900.00
Soft Costs (35%)				$376,200.00
Easement Acquisition (25' Width x 1150' Length x $0.35 per square foot)				$10,100.00
Total Estimated Project Cost				$1,461,200.00

C.O.W. Rank: 39 | **By:** JRH | **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-1	Twin Bridges	Wooded Acres	1964

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,410	814063/814058	752006	15±	From: Lockwood Dr (2 locations) To: Creek east of Indian Creek Rd

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8" VCP	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)		R.O.W. / Easements (Width)		Accessibility	
☑ Stuctural Deterioration/Failure	☐ Fat, Oil, and Grease	☑ Existing Easement	40 ft.	☑ Unable to Access	
☐ Inadequate Hydraulic Capacity	☑ Aerial Crossing(s)	☐ Existing R.O.W	ft.	☐ Interference:	
☐ Other: _____		☐ Requires Easement	ft.	Building, sign, etc.	

Comments

Lines are located in the rear of the lots; follow creek/ravine; heavily wooded area, difficult to access; sewer lines in a 40' drainage easement; record drawings indicate multiple aerial crossings on north line;

Highly Wooded Area

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☑ Single Family Residential	☐ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☐ Commercial	☑ Trees/Wood
☐ Industrial	☑ Creek
☐ Other: _____	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$30,000.00	$30,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	10	$1,250.00	$12,500.00
Aerial Crossing	LF	150	$300.00	$45,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	2410	$95.00	$228,950.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$401,500.00
Soft Costs (35%)				$140,500.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$542,000.00

C.O.W. Rank: 2 | **By:** JRH | **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-2	Twin Bridges	Wooded Acres	1966, 1993

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
3,660	802019	801025	450±	From: Oakview St (along Creek) To: Creek east of Savannah Ct

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-10" VCP, 12" PVC	8", 12"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 10 ft. & 20 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

10' easement from Oakview to Wooded Acres, 20' from Wooded Acres to end; two aerial crossing between last three manholes; all 8" will be installed using pipe bursting, all 12" will be installed by open cut; aerial crossing east of Turtle Creek, aerial crossings north of Wooded Acres

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$62,000.00	$62,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	14.5	$4,000.00	$58,000.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	430	$300.00	$129,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$10,000.00	$10,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	50	$275.00	$13,750.00
12" Gravity (All Depths) - Rural	LF	1500	$95.00	$142,500.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	25	$7,500.00	$187,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	100	$200.00	$20,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	2160	$95.00	$205,200.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$834,200.00
Soft Costs (35%)				$292,000.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,126,200.00

C.O.W. Rank: 10

By: JRH **Date:** 5/29/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-3	Twin Bridges	Wooded Acres	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,910	813043	801019	100±	From: Bishop Dr. To: Creek east of Wooded Acres Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8"	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 10 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Exposed in creek due to insufficient bury depth; heavily wooded area, difficult to access; line located in rear of lots along creek; potential pipe bursting project; 10' easement from 6" connection from Wooded Acres to end of project, easment needed from Bishop to 6" connection;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$23,000.00	$23,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	20	$1,250.00	$25,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS			$0.00
Landscape/Fence Repair	LS			$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	10	$7,500.00	$75,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	1910	$95.00	$181,450.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$314,500.00
Soft Costs (35%)				$110,100.00
Easement Acquisition (25' Width x 650' Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$424,600.00

C.O.W. Rank: 11

By: JRH **Date:** 5/28/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-4	Twin Bridges	Lake Shore	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,200	971048	974023	75±	From: Mt Carmel Dr To: Creek west of Oak Cliff Dr

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8" VCP	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)
- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)
- ☑ Existing Easement 630 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility
- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Parallel gravity and force main; force main in OK condition; line located in the rear of lots along ravine; heavily wooded area, difficult to access; potential pipe bursting project;

Highly Wooded Area

Land Use / Surface Cover:
- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$17,000.00	$17,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	12	$7,500.00	$90,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	30	$200.00	$6,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	1200	$95.00	$114,000.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$227,000.00
Soft Costs (35%)				$79,500.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$306,500.00

C.O.W. Rank: 27

By: JRH **Date:** 5/28/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-5	Twin Bridges	Twin Bridges	1987

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,980	1021010	1021082	650±	From: East of Cobbs Dr To: Bosque Blvd

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-18" VCP, PVC	8", 21", 24"	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 15 & 20 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Includes 6" from Cobbs Dr to La Porte Dr on Cobbs and parallel alignments behind Providence Health Clinic beginning at the intersection of Fish Pond Rd and La Porte Dr; second line from Fish Pond to Bosque was installed in 1987 with PVC;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☑ Yard
- ☐ Field
- ☑ Trees/Wood
- ☐ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$63,000.00	$63,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	17.5	$4,000.00	$70,000.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	400	$100.00	$40,000.00
16" Boring and Casing	LF	80	$275.00	$22,000.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	9	$7,500.00	$67,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	60	$200.00	$12,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	1200	$175.00	$210,000.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	5	$10,500.00	$52,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	75	$275.00	$20,625.00
Trenchless				
8" Pipe Bursting	LF	310	$95.00	$29,450.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
24" Gravity (All Depths) - Rural	LF	1070	$200.00	$214,000.00
Construction Subtotal				$842,300.00
Soft Costs (35%)				$294,800.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$1,137,100.00

C.O.W. Rank: 37

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-6	Twin Bridges	Twin Bridges	?

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
750	1024009	1021082	10±	From: Valeska Dr To: Bosque Blvd

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6" VCP	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☐ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 15 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

Line is located at the rear of lots; heavily wooded area, difficult to access; potential pipe bursting project; no easement shown for beginning of project;

Highly Wooded Area

Land Use / Surface Cover:

☐ Rural Residential	☐ Street/Alley
☑ Single Family Residential	☑ Parking Lot
☐ Public/Semi-Public	☐ Yard
☐ Parks/Open Space	☐ Field
☑ Commercial	☑ Trees/Wood
☐ Industrial	☐ Creek
☐ Other: _____	☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$11,000.00	$11,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	8	$1,250.00	$10,000.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$0.00	$0.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	50	$200.00	$10,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	750	$95.00	$71,250.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$147,300.00
Soft Costs (35%)				$51,600.00
Easement Acquisition (25' Width x 150' Length x $0.35 per square foot)				$1,400.00
Total Estimated Project Cost				$200,300.00

C.O.W. Rank: 44

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-7	Twin Bridges	Twin Bridges	1956, 1990

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
1,790	1021111	1022102	800±	From: Rambler Dr To: Abandoned Country Club LS

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
8"-18" VCP, PVC	8", 12", 24"	☑ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 10 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☑ Interference: Building, sign, etc.

Comments

Aerial Crossing near the intersection of Rambler Dr and Bosque Blvd, and near abandoned lift station; because of proposed pipe size of TB-6, assumed increase in pipe size for pipe from Bosque crossing to end of project; assumed 8" and 10" pipe bursting, 24" open cut;

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$36,000.00	$36,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	10	$4,000.00	$40,000.00
Sanitary Sewer Service	EA	0	$1,250.00	$0.00
Aerial Crossing	LF	50	$300.00	$15,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$0.00	$0.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	3	$7,500.00	$22,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	25	$200.00	$5,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	5	$10,500.00	$52,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	40	$275.00	$11,000.00
Trenchless				
8" Pipe Bursting	LF	545	$95.00	$51,775.00
10" Pipe Bursting	LF	235	$115.00	$27,025.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
24" Gravity (All Depths) - Rural	LF	960	$200.00	$192,000.00
Construction Subtotal				$477,800.00
Soft Costs (35%)				$167,200.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$645,000.00

C.O.W. Rank: 19

By: JRH **Date:** 4/9/14

City Identified Projects Form

Project Number:	Major Basin:	Minor Basin:	As-Built Date
TB-8	Twin Bridges	Twin Bridges	1962, 1971

Length (FT)	Upstream Manhole ID	Downstream Manhole ID	Approx. Upstream Conn.	Location (Nearest Street Intersection)
2,360	1022063	1022102	500±	From: Harvey Dr To: Abandoned Country Club LS

Ex. Pipe Diameter (IN) / Type	Prop. Pipe Diameter (IN)	Recommended Replacement Type
6-8" VCP	8"	☐ Open Cut ☐ Other: _____ ☑ Trenchless

Noted Condition(s)

- ☑ Stuctural Deterioration/Failure
- ☐ Fat, Oil, and Grease
- ☐ Inadequate Hydraulic Capacity
- ☑ Aerial Crossing(s)
- ☐ Other: _____

R.O.W. / Easements (Width)

- ☑ Existing Easement 10-30 ft.
- ☐ Existing R.O.W ft.
- ☐ Requires Easement ft.

Accessibility

- ☑ Unable to Access
- ☐ Interference: Building, sign, etc.

Comments

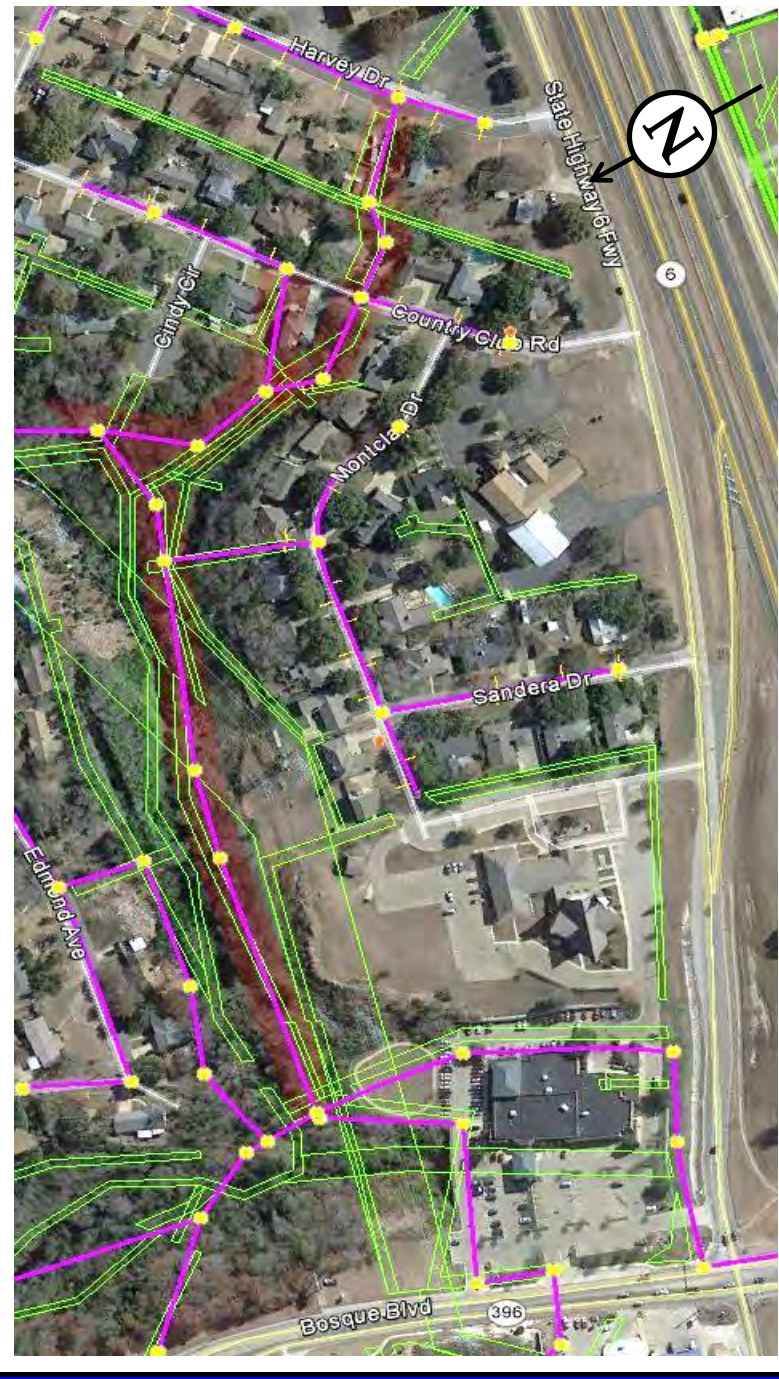
Line is located in the side and rear of lots, potential pipe bursting project; heavily wooded area, difficult to access; multiple easements with different widths

Highly Wooded Area

Land Use / Surface Cover:

- ☐ Rural Residential
- ☑ Single Family Residential
- ☐ Public/Semi-Public
- ☐ Parks/Open Space
- ☐ Commercial
- ☐ Industrial
- ☐ Other: _____
- ☐ Street/Alley
- ☐ Parking Lot
- ☐ Yard
- ☐ Field
- ☑ Trees/Wood
- ☑ Creek
- ☐ Other: _____

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$32,000.00	$32,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	0	$4,000.00	$0.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Aerial Crossing	LF	0	$300.00	$0.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Gravity (All Depths) - Rural	LF	0	$65.00	$0.00
8" Gravity (All Depths) - Urban	LF	0	$100.00	$0.00
16" Boring and Casing	LF	0	$275.00	$0.00
12" Gravity (All Depths) - Rural	LF	0	$95.00	$0.00
12" Gravity (All Depths) - Urban	LF	0	$120.00	$0.00
18" Boring and Casing	LF	0	$325.00	$0.00
15" Gravity (All Depths) - Rural	LF	0	$125.00	$0.00
15" Gravity (All Depths) - Urban	LF	0	$140.00	$0.00
24" Boring and Casing	LF	0	$425.00	$0.00
4' Diameter Concrete Manhole	EA	15	$7,500.00	$112,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	75	$200.00	$15,000.00
18" Gravity (All Depths) - Rural	LF	0	$150.00	$0.00
18" Gravity (All Depths) - Urban	LF	0	$165.00	$0.00
21" Gravity (All Depths) - Rural	LF	0	$175.00	$0.00
21" Gravity (All Depths) - Urban	LF	0	$190.00	$0.00
30" Boring and Casing	LF	0	$525.00	$0.00
6' Diameter Concrete Manhole	EA	0	$10,500.00	$0.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	0	$275.00	$0.00
Trenchless				
8" Pipe Bursting	LF	2360	$95.00	$224,200.00
10" Pipe Bursting	LF	0	$115.00	$0.00
12" Pipe Bursting	LF	0	$130.00	$0.00
15" Pipe Bursting	LF	0	$140.00	$0.00
Construction Subtotal				$420,000.00
Soft Costs (35%)				$147,000.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$0.00
Total Estimated Project Cost				$567,000.00



C.O.W. Rank: 20

By: JRH **Date:** 4/9/14

Table A1. Residential population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
1	1.00	328	124.93	725
2	1.00	720	38.92	1,275
3	1.00	251	62.82	600
4	1.00	442	93.50	830
5	1.00	104	66.53	500
6	1.00	92	35.03	200
7	1.00	1,320	61.97	1,450
8	1.00	1,757	96.58	2,050
9	0.71	356	55.07	496
10**	0.00	0	n/a	0
11**	0.00	0	n/a	0
12	1.00	4,214	22.07	4,220
13	1.00	526	45.59	1,055
14	1.00	335	122.10	500
15	1.00	1,832	71.15	1,910
16	1.00	1,043	55.24	1,350
17**	0.00	0	n/a	0
18	1.00	1,736	42.72	1,930
19	1.00	850	71.71	1,255
20	1.00	1,530	47.18	1,700
21	1.00	714	46.88	840
22	1.00	332	56.99	550
23	1.00	411	47.54	720
24	1.00	468	67.19	601
25	1.00	355	80.05	400
26	1.00	337	51.86	460
27	1.00	1,237	50.88	1,400
28	1.00	775	48.91	910
29	1.00	1,005	54.72	1,115
30	1.00	1,972	51.97	2,115
31	1.00	2,032	56.11	2,125
32	1.00	1,298	56.46	1,425
33	1.00	1,958	52.99	2,110
34	1.00	455	50.74	625
35	1.00	2,117	54.02	2,260
36	1.00	1,366	53.21	1,525
37	1.00	662	54.99	750
38	1.00	463	62.99	580
39	1.00	1,786	49.82	1,910
40	1.00	719	50.58	835
41	1.00	1,446	52.77	1,610
42	1.00	1,797	45.92	2,000
43	1.00	1,262	44.76	1,500
44	1.00	525	50.56	650
45	1.00	55	87.69	70

* Flow rate determined from spatial average
** No population present in planning estimates

Table A1 (continued). Residential population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
46	1.00	142	39.08	142
47	1.00	217	85.37	217
48	1.00	487	35.56	487
49	1.00	101	53.55	275
50	1.00	122	69.64	300
51**	0.00	0	n/a	0
52*	0.07	28	59.90	28
53*	0.53	4	61.41	0
54	0.96	1,313	61.41	1,585
55	0.53	542	56.26	597
56	1.00	185	44.04	300
57	1.00	1,015	77.19	950
58	1.00	880	59.98	1,010
59	1.00	439	80.98	650
60	1.00	1,221	67.79	1,355
61	1.00	647	59.34	850
62	1.00	484	55.93	760
63	1.00	69	27.17	250
64	1.00	271	56.57	710
65	1.00	97	58.27	200
66	1.00	957	82.90	1,000
67*	1.00	97	74.18	200
75*	0.14	40	54.90	62
77	1.00	42	37.40	350
78**	0.00	0	n/a	0
88**	0.00	0	n/a	0
89*	0.22	32	58.30	65
90	1.00	774	55.41	850
91	0.48	221	68.42	289
92**	0.00	0	n/a	0
95	1.00	2,540	61.30	2,620
96	1.00	386	62.44	560
97	1.00	1,377	49.90	1,475
98	1.00	415	75.51	900
99	0.46	16	97.91	23
100	0.40	1	191.25	0
101*	1.00	1	66.08	0
110**	1.00	0	n/a	0
111	1.00	11	27.98	5
112	0.98	878	69.26	883
113	1.00	229	52.95	300
114	1.00	654	63.00	660
115	0.29	185	132.22	186
117**	0.00	0	n/a	0
118	1.00	1,393	52.29	1,850
119	1.00	410	49.79	600

* Flow rate determined from spatial average
** No population present in planning estimates

Table A1 (continued). Residential population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
120	1.00	1,086	53.33	1,260
121	1.00	1,677	56.03	2,000
122	1.00	286	49.81	1,000
123	1.00	1,229	47.84	1,360
124	1.00	372	54.45	390
125**	0.00	0	n/a	0
126**	0.00	0	n/a	0
127	1.00	72	78.74	300
128**	0.00	0	n/a	0
129*	1.00	0	67.50	425
130	1.00	1,589	102.18	1,700
131	1.00	818	106.17	960
132	1.00	652	73.67	750
133**	0.00	0	n/a	0
134	1.00	978	117.57	1,000
135	1.00	1,687	61.14	1,850
136	1.00	839	69.94	950
137	1.00	1,184	74.35	1,300
139	1.00	1	15.63	150
140	0.96	753	147.98	839
141	1.00	333	114.96	550
142	1.00	1,721	71.88	1,860
143	1.00	531	84.61	630
144	0.93	561	30.44	625
145	0.42	197	60.45	274
146**	0.00	0	n/a	0
150	1.00	694	108.16	750
151	1.00	910	126.01	910
152	1.00	456	229.99	456
153	1.00	508	100.79	650
154	1.00	560	100.70	660
155	1.00	1,077	85.85	1,160
156	1.00	866	90.09	920
157	1.00	1,421	69.06	1,510
158	1.00	2,332	54.08	2,500
159**	0.00	0	n/a	0
160	1.00	2,298	122.42	2,400
161	0.98	826	116.42	885
162	1.00	450	67.46	525
167	0.36	177	122.31	343
169**	0.00	0	n/a	0
170*	1.00	30	77.65	50
171	1.00	644	21.26	1,180
172	1.00	1,547	74.58	1,770

* Flow rate determined from spatial average
** No population present in planning estimates

Table A1 (continued). Residential population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
173	1.00	1,144	72.64	1,250
174	1.00	170	69.02	360
175*	0.36	6	72.53	143
176*	0.12	8	61.41	35
177**	0.00	0	n/a	0
178**	0.00	0	n/a	0
179	0.74	154	110.09	369
180	0.96	659	72.53	959
181	0.58	28	91.16	17
182**	0.00	0	n/a	0
183	0.39	47	83.47	68
184	1.00	344	68.66	550
185	0.99	480	76.10	583
214**	0.00	0	n/a	0
215**	0.00	0	n/a	0
216**	1.00	0	n/a	0
217	0.93	919	79.63	994
218**	0.00	0	n/a	0
219**	0.00	0	n/a	0
221	1.00	433	92.21	1,100
222	1.00	2,466	66.54	3,050
225**	0.00	0	n/a	0
226	0.35	121	79.03	450
228	1.00	176	66.60	350
229**	0.00	0	n/a	0
230**	0.00	0	n/a	0
235	0.96	764	74.76	1,441
236	0.17	22	30.21	67
237	1.00	2,267	74.24	3,000
238	1.00	425	51.23	1,200
239	0.30	65	98.05	211
240	0.53	146	78.32	370
241	0.67	34	126.89	236
242	0.95	402	74.49	1,420
247	0.59	252	288.20	709
252**	0.00	0	n/a	0
253**	0.00	0	n/a	0
255	1.00	1,578	87.91	1,700
256	1.00	702	61.56	750
257	0.79	623	32.89	690
258**	0.00	0	n/a	0
259**	0.00	0	n/a	0
260**	1.00	0	n/a	0
261	0.97	888	100.13	1,546
265	0.96	1,424	74.21	2,121

* Flow rate determined from spatial average
** No population present in planning estimates

Table A1 (concluded). Residential population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
304	0.13	117	43.36	165
320	1.00	41	45.46	180
349	1.00	72	91.03	150
350	1.00	221	62.90	350
351	1.00	12	46.25	75
352	1.00	396	55.92	545
353	1.00	201	96.85	275
354	1.00	113	104.41	150
355	1.00	159	117.44	200
356*	1.00	0	88.80	250
357	1.00	30	79.55	300
358**	0.00	0	n/a	0
359	1.00	1,248	93.45	1,425
360	1.00	596	13.33	1,075
361**	0.00	0	n/a	0
362**	1.00	0	n/a	0
363	1.00	565	47.17	690
364**	0.00	0	n/a	0
365	1.00	272	69.26	450
366	1.00	142	68.48	420
367*	0.91	0	65.00	341
368**	0.00	0	n/a	0
371	1.00	223	37.16	250
372	1.00	24	55.63	30
373	1.00	944	71.49	1,000
374	1.00	541	64.31	630
376	1.00	884	40.03	1,125
377**	0.00	0	n/a	0
378	1.00	312	47.08	500
379**	0.00	0	n/a	0
380	1.00	309	101.99	660
381*	1.00	0	100.19	75
382	1.00	515	96.89	625
404	1.00	129	54.70	300
405	1.00	9	73.93	0
406**	0.00	0	n/a	0
407	1.00	62	25.84	30
411	0.93	639	242.60	1,119
412	0.94	969	92.03	1,476
413	0.86	1,078	102.84	1,703
424*	1.00	0	81.17	400
426	1.00	1,348	81.58	1,500
427	1.00	440	77.10	600
428**	0.00	0	n/a	0

* Flow rate determined from spatial average
** No population present in planning estimates

Table A2. Commercial population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
1	1.00	784	30.63	960
2	1.00	3,290	18.85	3,490
3	1.00	643	50.27	870
4	1.00	530	83.63	750
5	1.00	1,708	11.10	1,890
6	1.00	501	22.35	575
7	1.00	206	27.30	420
8	1.00	101	139.71	190
9*	0.71	2	243.88	18
10	0.00	307	104.67	470
11	0.00	99	67.07	0
12	1.00	2,559	59.62	2,855
13	1.00	630	54.51	690
14	1.00	55	279.70	130
15	1.00	285	178.04	380
16	1.00	264	78.35	300
17	0.00	427	32.90	495
18	1.00	201	49.71	285
19	1.00	389	60.76	460
20	1.00	241	286.87	310
21	1.00	367	35.63	365
22	1.00	480	30.64	500
23	1.00	330	31.96	245
24	1.00	1,167	34.01	1,190
25	1.00	684	11.63	710
26	1.00	58	33.70	105
27	1.00	84	61.96	120
28	1.00	195	49.72	210
29	1.00	25	144.20	95
30	1.00	41	63.83	105
31	1.00	84	44.96	110
32	1.00	544	80.83	805
33	1.00	62	123.62	120
34	1.00	353	16.52	525
35	1.00	130	49.24	217
36	1.00	51	130.14	160
37	1.00	9	335.92	15
38	1.00	65	39.27	85
39	1.00	164	106.32	200
40	1.00	31	100.21	60
41	1.00	204	37.15	235
42	1.00	64	431.81	245
43	1.00	221	69.75	370
44*	1.00	67	26.52	110
45*	1.00	20	70.99	40

* Flow rate determined from spatial average
** No population present in planning estimates

Table A2 (continued). Commercial population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
46	1.00	297	42.39	300
47*	1.00	1	42.66	5
48	1.00	384	28.89	350
49	1.00	100	570.94	180
50*	1.00	464	43.75	555
51	0.00	8	213.15	10
52	0.07	21	411.67	25
53	0.53	690	570.28	725
54	0.96	254	27.34	331
55	0.53	90	46.46	111
56*	1.00	0	44.15	5
57	1.00	226	34.05	235
58	1.00	60	93.42	110
59	1.00	75	113.13	100
60	1.00	77	33.10	190
61	1.00	109	87.33	240
62	1.00	91	141.91	230
63	1.00	11	350.09	220
64	1.00	81	64.20	240
65	1.00	43	43.23	150
66	1.00	34	42.18	100
67	1.00	11	15.76	275
75	0.14	9	457.44	17
77	1.00	8	62.38	185
78	0.00	7	247.02	8
88*	0.00	5	63.00	40
89**	0.22	0	n/a	0
90*	1.00	80	49.17	110
91	0.48	69	13.00	72
92	0.00	359	419.59	382
95	1.00	163	250.80	215
96	1.00	98	30.44	125
97	1.00	107	80.20	135
98	1.00	39	104.74	180
99*	0.46	144	129.97	132
100**	0.40	0	n/a	0
101	1.00	19	243.99	40
110	1.00	43	71.43	165
111	1.00	298	32.65	345
112	0.98	208	15.05	300
113	1.00	17	329.12	70
114	1.00	66	239.56	85
115	0.29	16	23.77	23
117*	0.00	917	31.32	1,500
118	1.00	212	265.98	455
119	1.00	307	92.23	355

* Flow rate determined from spatial average
** No population present in planning estimates

Table A2 (continued). Commercial population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
120	1.00	172	72.44	215
121	1.00	320	60.40	430
122	1.00	259	95.26	360
123	1.00	189	55.84	265
124	1.00	591	11.51	832
125	0.00	910	49.39	970
126	0.00	824	56.17	865
127	1.00	546	46.59	660
128*	0.00	1,099	54.04	1,135
129	1.00	1,573	34.53	1,725
130	1.00	1,554	28.40	1,610
131	1.00	557	81.65	610
132	1.00	478	41.94	550
133*	0.00	701	35.64	750
134	1.00	681	27.87	745
135	1.00	246	55.35	315
136	1.00	179	54.21	185
137	1.00	475	38.87	540
139	1.00	411	25.29	560
140	0.96	211	27.20	260
141	1.00	1,050	10.95	1,130
142	1.00	938	26.45	1,045
143	1.00	718	19.72	805
144*	0.93	232	133.79	326
145	0.42	337	72.39	398
146*	0.00	21	26.43	25
150	1.00	128	49.51	120
151*	1.00	8	120.94	5
152	1.00	199	360.81	200
153	1.00	492	100.82	640
154	1.00	800	28.58	895
155*	1.00	31	50.48	50
156	1.00	110	116.21	134
157	1.00	211	41.20	245
158	1.00	84	64.01	170
159	0.00	598	68.77	765
160	1.00	89	39.07	110
161	0.98	293	16.41	364
162	1.00	53	19.73	65
167	0.36	4	358.47	2
169	0.00	17	29.68	131
170**	1.00	0	n/a	0
171	1.00	382	17.12	635
172	1.00	302	92.03	417

* Flow rate determined from spatial average
** No population present in planning estimates

Table A2 (continued). Commercial population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
173	1.00	111	54.67	160
174	1.00	1,111	24.08	1,170
175	0.36	38	94.99	61
176*	0.12	5	34.24	6
177	0.00	23	136.33	125
178	0.00	1	183.73	37
179*	0.74	95	86.84	111
180	0.96	31	15.63	125
181	0.58	34	53.17	41
182	0.00	94	98.39	216
183	0.39	9	330.04	12
184	1.00	321	18.77	510
185	0.99	29	183.69	25
214	0.00	48	10.71	290
215	0.00	740	48.02	890
216*	1.00	1,224	16.17	1,575
217	0.93	1,394	311.89	1,556
218	0.00	1,304	248.72	1,485
219	0.00	1,592	14.19	1,790
221*	1.00	281	311.89	245
222*	1.00	126	88.48	225
225*	0.00	28	204.75	32
226*	0.35	11	105.50	26
228	1.00	1,088	26.83	1,295
229	0.00	989	15.87	1,295
230	0.00	46	54.13	82
235	0.96	158	62.17	245
236**	0.17	0	n/a	0
237	1.00	99	218.37	315
238	1.00	22	57.39	60
239*	0.30	3	95.67	6
240	0.53	125	35.30	146
241**	0.67	0	n/a	0
242*	0.95	10	110.38	14
247	0.59	8	36.75	6
252*	0.00	15	42.42	20
253	0.00	521	27.76	675
255	1.00	263	256.29	325
256	1.00	431	76.50	510
257	0.79	304	105.50	347
258*	0.00	17	30.30	8
259	0.00	499	35.97	575
260*	1.00	396	80.75	500
261	0.97	1,654	93.80	2,149
265*	0.96	2	105.50	0

* Flow rate determined from spatial average
** No population present in planning estimates

Table A2 (concluded). Commercial population and wastewater flow based on winter average monthly water usage.

TAZ	Land Parcel Ratio	Current		Future
		Adjusted 2010 Population	Wastewater Flow (gallons/person/day)	Adjusted 2040 Population
304	0.13	23	12.30	29
320	1.00	40	11.81	60
349	1.00	28	46.38	60
350	1.00	5	128.73	70
351*	1.00	21	28.59	15
352	1.00	3	142.90	50
353*	1.00	4	41.65	5
354	1.00	2	14.48	10
355	1.00	14	107.16	20
356	1.00	839	25.55	945
357	1.00	195	64.89	255
358	0.00	19	99.93	40
359	1.00	611	27.43	655
360	1.00	3,600	70.58	3,940
361	0.00	884	16.05	1,020
362	1.00	791	19.64	840
363	1.00	2	185.33	15
364	0.00	272	53.88	225
365	1.00	189	105.63	180
366	1.00	80	158.99	135
367	0.91	87	93.23	327
368	0.00	185	40.92	230
371**	1.00	0	n/a	0
372**	1.00	0	n/a	0
373	1.00	17	25.06	5
374*	1.00	11	37.06	15
376	1.00	135	13.84	207
377	0.00	283	21.27	325
378	1.00	11	164.10	65
379	0.00	297	25.88	460
380*	1.00	159	215.00	275
381*	1.00	2	132.29	0
382	1.00	8	71.08	5
404	1.00	137	23.15	230
405**	1.00	0	n/a	0
406	0.00	77	154.79	95
407	1.00	53	96.50	85
411	0.93	142	32.84	191
412	0.94	76	456.90	127
413	0.86	118	42.49	183
424	1.00	1,074	19.86	1,225
426*	1.00	114	39.37	175
427	1.00	67	34.52	125
428	0.00	522	14.19	445

* Flow rate determined from spatial average
** No population present in planning estimates

	TRADITIONAL ENGINEERING ELEMENTS												SOCIAL, POLITICAL, AND ECONOMICAL ELEMENTS					
	GRAVITY (REHAB ONLY - NOT CAPACITY RELATED)						FORCE MAIN & LIFT STATION (FORCE MAIN ONLY OR LIFT STATION ONLY)											
SCORING CRITERIA	RISK AVOIDANCE	STURCTURAL INTEGRITY		HYDRAULIC CAPACITY / RELIABILITY		PREDECESSOR FOR OTHER PROJECTS	RISK AVOIDANCE	STURCTURAL INTEGRITY	HYDRAULIC CAPACITY / RELIABILITY		RISK AVOIDANCE / STRUCTURAL INTEGRETY / HYDRAULIC CAPACITY	PREDECESSOR FOR OTHER PROJECTS	EFFECT ON PUBLIC SAFETY	IMPROVEMENT FOR ECONOMIC DEVELOPMENT / REDEVELOPMENT	RETURN ON INVESTMENT	SUSTAINABILITY	TIME TO IMPLEMENT OR CONSTRUCT	OVERALL PROJECT SCORE
	Ex. Pipe Diameter	Pipe Material Type	Pipe Age	Pipe Capacity	Wastewater Overflow Volume		Ex. Force Main Diameter	Force Main Condition	Force Main Capacity	Wastewater Overflow Volume	Lift Station Assessment[1]							
MAXIMUM POINTS	20	10 (20)	10 (20)	10 (0)	10 (0)	10	10 (20)	10 (20)	5 (10)	5 (10)	30 (60)	10	3	3	3	3	3	**85**
WEIGHTED SCORE	• 4: ≤ 12-inch • 8: 15-inch - 18-inch (approx. 8% of system) • 12: 21-inch - 24-inch (approx. 4% of system) • 16: 27-inch - 33-inch (approx. 1% of system) • 20: >33-inch (approx. 1% of system)	• 0: PVC • 4(8): Null/Void or Other • 6(12): DIP • 8(16): VCP • 10(20): RCP	• 0: 2000-Current • 2(4): 1990 - 1999 • 4(8): 1980 - 1989 or Null/Void • 6(12): 1970 - 1979 • 8(16): 1960 - 1969 • 10(20): Before 1960	• 0: <80% Full • 2: 80% - Pipe Full • 4: Pipe Full (Not Capacity Limited) • 6: Under Capacity (>2' from ground) • 8: Surcharged (<2' from ground) • 10: Modeled Overflows	• 0: None • 5: Moderate • 10: High	• 0 - 3: Low • 4 - 7: Medium • 8 - 10: High	• 2 (4): < 12-inch • 4 (8): 12-inch (approx. 20% of system) • 6 (12): 14-inch (approx. 2.7% of system) • 8 (16): 16-inch (approx. 10.4% of system) • 10 (20): ≥ 36-inch (approx. 0.2% of system)	• 2 (4): Very Good • 4 (8): Good • 6 (12): Fair • 8 (16): Poor • 10 (20): Very Poor	• 1 (2): Vel < 6FPS • 3 (6): 6FPS < Vel < 10 FPS • 5 (10): Vel > 10 FPS	• 0: None • 5 (10): Yes	• 1-9 (1-19): Recommended +20 Year CIP • 10-19 (20-39): Recommended 11-20 Year CIP • 20-30 (40-60): Recommended 1-10 Year CIP	• 0 - 3: Low • 4 - 7: Medium • 8 - 10: High	• 1: Low • 2: Medium • 3: High	• 1: Low • 2: Medium • 3: High	• 1: Low • 2: Medium • 3: High	• 1: Low • 2: Medium • 3: High	• 1: Permitting / R.O.W. / Easements > 10 • 2: Minor R.O.W/ Easements • 3: No Land Acquisition / Easements	**Max Total Criteria Score of 85 points based on Team scoring criteria.**
WMARSS Project No. 1 - LaSalle Lift Station Relocation & Force Main Extension to Central Plant *							10	10	5	5	30	10	3	3	3	3	1	**83**
Reroute Brazos Basin Flows from West Bank (Lower Limits)	18	9	9	10	10	9							3	3	3	3	2	**79**
West Bank Interceptor CIPP Rehabilitation (IH-35 to Clifton Robinson Tower and University Parks Science Building to Ferrell Center)	20	20	20	REHAB	REHAB	2							3	1	2	2	3	**73**
Brazos Basin Interceptor (Upper Limits) and Reroute Landon Branch Flows from West Bank Interceptor	12	9	9	10	10	8							3	3	3	3	2	**72**
Rehabilitation of Remaining Portions of West Bank Interceptor	18	20	20	REHAB	REHAB	2							3	1	2	2	1	**69**
Village Lake Lift Station Added Pumping Capacity											54	1	3	2	2	2	3	**67**
Replace Church Road Lift Station Force Main (Possible added pumping capacity)							2	8	2	5	30	6	3	2	3	2	1	**64**
Added Pumping Capacity at Landon Branch Lift Station											51	4	3	1	1	1	3	**64**
Reroute Church Road Lift Station Flows from South Flat Creek WW Line to Bull Hide /Castleman Creek WWL	12	7	6	10	5	7							3	3	3	1	2	**59**
WMARSS Project No. 2 - Lacy Lakeview / Bellmead / TSTC Interceptor *	16	10	6	10	10	8							3	2	3	2	1	**71**
WMARSS Project No. 4 - Replace Lower Limits of Cottonwood Interceptors *	20	10	6	4	0	5							3	3	2	2	2	**57**
Reroute Greenleaf, Village Green, Park Lake and Chimney Hill Lift Station's											48 **	3	1	1	1	1	1	**56**
Abandon Existing Lindsey Hollow Lift Station and Gravity Extension											48	0	1	1	1	2	2	**55**
WMARSS Project No. 3 - Rehabilitate Bellmead Interceptor *	16	20	12	REHAB	REHAB	0							3	3	2	2	2	**60**
WMARSS Project No. 5 - Replace Middle Section of Cottonwood Interceptors *	16	10	6	4	0	3							3	3	1	2	2	**50**
Added pumping capacity at TSTC lift station and force main improvements							4	10	1	5	20	0	3	2	1	2	2	**50**
Reroute Wooded Acres LS flow to Landon Branch LS							8	20	0	0		6	3	3	2	1	3	**46**
Syrian Club Lift Station Rehabilitation											40	0	1	1	1	1	1	**45**
Barron's Branch- Added Capacity Line from 12th Street and Barrons's to West Bank Interceptor	10	4	5	10	5	0							3	2	1	1	2	**43**
Lake Shore Lift Station Rehabilitation											36	0	1	1	1	1	3	**43**
Cottonwood Basin - Added Capacity Line from Hiland Drive to Target	12	6	6	6	0	1							3	3	2	1	2	**42**
Gravity Line Upstream of Church Road Lift Station	4	4	0	10	5	2							2	2	2	1	3	**35**
Abandon McLennan County Jail Lift Station and Gravity Extension to WMARSS LaSalle Lift Station							2	1	0	0	20	0	1	1	1	2	3	**31**

[1] Lift Station score weighted on Table 3.5-3: Condition / Capacity Risk Matrix (Tech. Memo. No. 7)

* Scored per February 2013 WMARSS Large Diameter Interceptor Improvements Report

** Based upon average of Greenleaf, Village Green, and Park Lake LS scores (Table 3.5-3; Tech. Memo. No. 7)

*** Future Added Capacity Only project

CIP Project Index

1. LaSalle Lift Station Improvements & Force Main Extension (WMARSS Proj No. 1)
2. West Bank Interceptor Rehabilitation (IH-35 to Clifton-Robinson Tower & University Parks Science Building to Ferrel Center)
3. 2015-2018 City Identified Asset Renewal Project No. 1
4. Brazos Basin Interceptor (Lower Limits)
5. Village Lake Hydraulic Capacity Improvements
6. Reroute Church Road Lift Station Flows from South Flat Creek WWL to Bull Hide/Castleman Creek WWL
7. Brazos Basin Interceptor (Upper Limits) and Reroute Landon Branch Lift Station Flows from West Bank Interceptor
8. Lacy Lakeview / Bellmead / TSTC Interceptor (WMARSS Proj No. 2)
9. Church Road Lift Station Added Pumping Capacity and Force Main Replacement
10. 2019-2022 Asset Renewal Project No. 2
11. West Bank Interceptor Rehabilitation (Part 2)
12. Bellmead Interceptor Rehabilitation (WMARSS Proj No. 3)
13. Reroute Wooded Acres Lift Station Flows from Cottonwood Basin to Brazos Basin Interceptor
14. Landon Branch Lift Station Added Pumping Capacity
15. TSTC Lift Station Added Pumping Capacity and Force Main Improvements
16. Abandon Existing Lindsey Hollow Lift Station and Gravity Extension
17. Barron's Branch - Added Capacity from 12th Street/Barrons to West Bank Int.
18. Replace Lower Limits of Cottonwood Interceptors (WMARSS Proj No. 4)
19. Cottonwood Basin Added Capactiy WWL
20. 2023-2026 Asset Renewal Project No. 3
21. Abandon McLennan County Jail Lift Station and Gravity Extension to WMARSS LaSalle Lift Station
22. Lake Shore Lift Station
23. Replace Middle Section of Cottonwood Interceptors (WMARSS Proj No. 5)
24. Gravity Line Upstream of Church Road Lift Station
25. Reroute Greenleaf, Village Green, Park Lake, and Chimney Hill Lift Stations
26. Syrian Club Lift Station

LEGEND

- Proposed / Rehabilitated City of Waco / WMARSS Gravity Line
- Proposed City of Waco / WMARSS Force Main
- Proposed / Rehabilitated City of Waco / WMARSS Lift Station
- Existing City of Waco Lift Station
- Existing WMARSS Lift Station

CITY OF WACO

0 1500 3000 6000

GRAPHIC SCALE (FEET)

Figure 8-1: 1-10 Year Capital Improvement Plan Projects

G:\GIS\Projects\1-0223\1\Maps\Tech Memo 9 - CIP Map.mxd

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
2	West Bank Interceptor Rehabilitation (Part 1)

Total Project Length (FT)	Location (Nearest Street Intersection)	
3,240	Begin Project:	S University Parks Drive & Clay Avenue
	End Project:	Daughtrey Avenue (Ferrell Center)

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 48", 54"	☐ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	30 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	125 ft.
☐ Lift Station Upgrades/Removal	☑ Other Rehabilitation	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$123,000.00	$123,000.00
Temporary Pump-Around By-Pass Pumping	LS	1	$40,000.00	$40,000.00
Open Trench				
Rehabilitation Depth for 7' Diameter Manhole	VF	160	$350.00	$56,000.00
Trenchless				
48" CIPP	LF	1160	$380.00	$440,800.00
54" CIPP	LF	2080	$480.00	$998,400.00
Construction Subtotal				$1,658,200.00
Engineering (12.5%)				$207,300.00
Construction Contingency (25%)				$414,600.00
Total Estimated Project Cost				$2,280,100.00

Comments

Begin rehabilitation of 48" where 15" connects just upstream of Clay Ave and University Parks Dr to beginning of 54" on west side of Interstate 35. Begin rehabilitiation of 54" just upstream of Waco Creek crossing to manhole at Daughtrey Ave in front of Ferrell Center.

Design Timeframe:	2015	Construction Timeframe:	2015	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
4	Brazos Basin Interceptor (Lower Limits)

Total Project Length (FT)	Location (Nearest Street Intersection)	
17,470	Begin Project:	2415 S University Parks Dr (Existing Transfer Lift Station)
	End Project:	Jackson Avenue Between S 18th Street and S 20th Street

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 36", 42", 48"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	40 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$1,129,000.00	$1,129,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	24.5	$4,000.00	$98,000.00
Sanitary Sewer Service	EA	70	$1,250.00	$87,500.00
Pavement Repair	LF	10510	$45.00	$472,950.00
Landscape/Fence Repair	LS	1	$25,000.00	$25,000.00
Open Trench				
36" Gravity (All Depths) - Urban	LF	3280	$475.00	$1,558,000.00
48" Boring and Casing	LF	200	$825.00	$165,000.00
6' Diameter Concrete Manhole	EA	15	$10,500.00	$157,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	160	$275.00	$44,000.00
42" Gravity (All Depths) - Urban)	LF	2350	$575.00	$1,351,250.00
60" Tunnel Liner Plate	LF	350	$1,000.00	$350,000.00
48" Gravity (All Depths) - Urban	LF	11840	$700.00	$8,288,000.00
66" Tunnel Line Plate	LF	450	$1,100.00	$495,000.00
7' Diameter Concrete Manhole	EA	55	$15,000.00	$825,000.00
Extra Depth for 7' Diameter Manhole Over 5' Deep	VF	550	$350.00	$192,500.00
Trenchless				

Construction Subtotal	$15,238,700.00
Engineering (12.5%)	$1,904,800.00
Construction Contingency (25%)	$3,809,700.00
Easement Acquisition (40' Width x 6040' Length x $0.35 per square foot)	$84,600.00
Total Estimated Project Cost	$21,037,800.00

Comments

Begin 48" gravity at the existing Transfer LS and end on the south side of I-35 and S 13th St; begin 42" and end at Waco ISD Middle School tie-in; begin 36" and end on northwest side of railroad track between S 18th St and S 20th St

Design Timeframe:	2015	Construction Timeframe:	2016-17	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
5	Village Lake Hydraulic Capacity Improvements

Total Project Length (FT)	Location (Nearest Street Intersection)	
2,715	Begin Project:	Intersection of Skeet Eason and Steinbeck Bend/Ave C
	End Project:	Intersection of Zoo Park Dr and Ave B

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 18"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	30 ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$95,000.00	$95,000.00
New Lift Station (1.5 MGD)	LS	1	$675,000.00	$675,000.00
Lift Station Demolition	LS	1	$20,000.00	$20,000.00
Open Trench				
18" Gravity (All Depths) - Urban	LF	2715	$150.00	$407,250.00
6' Diameter Concrete Manhole	EA	6	$10,500.00	$63,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	90	$275.00	$24,750.00
Trenchless				
Construction Subtotal				$1,285,000.00
Engineering (12.5%)				$160,600.00
Construction Contingency (25%)				$321,300.00
Total Estimated Project Cost				$1,766,900.00

Comments

Replace existing lift station, utilize existing 12" force main; tie existing force main into 18" gravity at Steinbeck Bend Dr and Skeet Eason Rd; end 18" at Zoo Park Dr and Avenue B.

Design Timeframe:	2015	Construction Timeframe:	2015-16	By:	JRH	Date:	5/12/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
6	Reroute Church Road Lift Station Flows to Bull Hide / Castleman Creek

Total Project Length (FT)	Location (Nearest Street Intersection)	
7,760	Begin Project:	Panther Way and Ritchie Road
	End Project:	Old McGregor Road and Ritchie Road

CITY OF WACO

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 21"	☑ Open Cut ☐ Other: _____
Force Main: 16"	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$123,000.00	$123,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	27	$4,000.00	$108,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
16" Force Main (All Depths) - Rural	LF	3650	$120.00	$438,000.00
24" Boring and Casing	LF	180	$425.00	$76,500.00
21" Gravity (All Depths) - Rural	LF	4110	$175.00	$719,250.00
30" Boring and Casing	LF	150	$525.00	$78,750.00
6' Diameter Concrete Manhole	EA	8	$10,500.00	$84,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	95	$275.00	$26,125.00
Trenchless				
Construction Subtotal				$1,663,625.00
Engineering (12.5%)				$208,000.00
Construction Contingency (25%)				$415,900.00
Easement Acquisition (25' Width x 7,760 Length x $0.35 per square foot)				$67,900.00
Total Estimated Project Cost				$2,355,425.00

Comments

Begin 16" force main extension of Church Road LS force main at existing outfall and end to south of the railroad overpass on Ritchie Rd; begin 21" gravity to connect 16" force main to new Ritchie Road Extension of the Bull Hide/Castleman Creek wastewater line at Ritchie Rd and Panther Way

Design Timeframe:	2016	Construction Timeframe:	2017-18	By:	JRH	Date:	5/8/15

Project Number:	Project Name
7	Brazos Basin Interceptor (Upper Limits) & Reroute of Landon Branch LS

Total Project Length (FT)	Location (Nearest Street Intersection)	
21,680	Begin Project:	Jackson Avenue Between S 18th Street and S 20th Street
	End Project:	2729 Glendale Drive (Existing Landon Branch Lift Station)

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 24"-36"	☑ Open Cut ☐ Other: _____
Force Main: 14"	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	40 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$682,000.00	$682,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	22.5	$4,000.00	$90,000.00
Sanitary Sewer Service	EA	55	$1,250.00	$68,750.00
Pavement Repair	LF	19160	$45.00	$862,200.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$50,000.00	$50,000.00
Open Trench				
14" Force Main (All Depths) - Urban	LF	3990	$120.00	$478,800.00
24" Gravity (All Depths) - Urban	LF	9275	$245.00	$2,272,375.00
36" Boring and Casing	LF	320	$660.00	$211,200.00
27" Gravity (All Depths) - Urban	LF	1725	$325.00	$560,625.00
30" Gravity (All Depths) - Urban	LF	3605	$350.00	$1,261,750.00
36" Gravity (All Depths) - Urban	LF	3080	$475.00	$1,463,000.00
48" Boring and Casing	LF	120	$825.00	$99,000.00
6' Diameter Concrete Manhole	EA	75	$10,500.00	$787,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	1050	$275.00	$288,750.00
Trenchless				

Construction Subtotal	$9,200,950.00
Engineering (12.5%)	$1,150,100.00
Construction Contingency (25%)	$2,300,200.00
Easement Acquisition (40' Width x 500' Length x $0.35 per square foot)	$7,000.00
Total Estimated Project Cost	$12,658,250.00

Comments

Begin 36" at end of Project 4 and end at N 23rd St and Austin Ave; begin 30" and end at N 28th St between Fort Ave and Waco Dr; begin 27" and end at N 30th St between Morrow Ave and Sanger Ave; begin 24" and end at N 35th St and Pine Ave; begin 14" force main and end at existing Landon Branch LS

Design Timeframe:	2017	Construction Timeframe:	2018-19	By:	JRH	Date:	5/8/15

Project Number:	Project Name
9	Church Road Lift Station Added Capacity and Force Main Replacement

Total Project Length (FT)	Location (Nearest Street Intersection)	
14,920	Begin Project:	669 Church Rd. (Existing Church Road Lift Station)
	End Project:	Old McGregor Road and Ritchie Road

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: ---	☑ Open Cut ☐ Other: _____
Force Main: 16"	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	35 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$239,000.00	$239,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	10.5	$4,000.00	$42,000.00
Pavement Repair	LF	5650	$45.00	$254,250.00
Lift Station Added Capacity (Expn. 1.5 MGD)	LS	1	$500,000.00	$500,000.00
Open Trench				
16" Force Main (All Depths) - Urban	LF	14920	$140.00	$2,088,800.00
24" Boring and Casing	LF	250	$425.00	$106,250.00
Trenchless				
Construction Subtotal				$3,230,300.00
Engineering (12.5%)				$403,800.00
Construction Contingency (25%)				$807,600.00
Total Estimated Project Cost				$4,441,700.00

Comments

Replace original Church Road LS 12" force main with new 16" force main; connect with new 16" force main (1-10 Year Project No. 6); assumed that entire concrete path would need to be replaced

Design Timeframe:	2018	Construction Timeframe:	2019-20	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
11	West Bank Interceptor Rehabilitation (Part 2)

Total Project Length (FT)	Location (Nearest Street Intersection)	
6,900	Begin Project:	S University Parks Drive and Webster Avenue
	End Project:	Cameron Park Drive

CITY OF WACO

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 30", 36"	☐ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☑ Other Rehabilitation	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$127,000.00	$127,000.00
Pavement Repair	LF	100	$45.00	$4,500.00
Temporary Pump-Around By-Pass Pumping	LS	1	$80,000.00	$80,000.00
Open Trench				
Rehabilitation Depth for 6' Diameter Manhole	VF	210	$275.00	$57,750.00
Rehabilitation Depth for 7' Diameter Manhole	VF	110	$350.00	$38,500.00
Trenchless				
30" CIPP	LF	4410	$190.00	$837,900.00
36" CIPP	LF	2490	$230.00	$572,700.00
Construction Subtotal				$1,718,350.00
Engineering (12.5%)				$214,800.00
Construction Contingency (25%)				$429,600.00
Total Estimated Project Cost				$2,362,750.00

Comments

Begin CIPP of 36" where 36" and 21" connect at Webster and University Parks to size change from 42" to 36" at Washington and University Parks; begin again where pipe changes from 36" to 42" on north side of bridge over Barron's Brach to service entrance to Cameron Park Zoo on Cameron Park Dr where pipe changes from 24" to 30"

Design Timeframe:	2019	Construction Timeframe:	2020	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
13	Reroute of Wooded Acres Lift Station Flows to Brazos Basin Int.

Total Project Length (FT)	Location (Nearest Street Intersection)	
7,935	Begin Project:	Existing Wooded Acres Lift Station
	End Project:	N 35th Street and Pine Avenue

CITY OF WACO

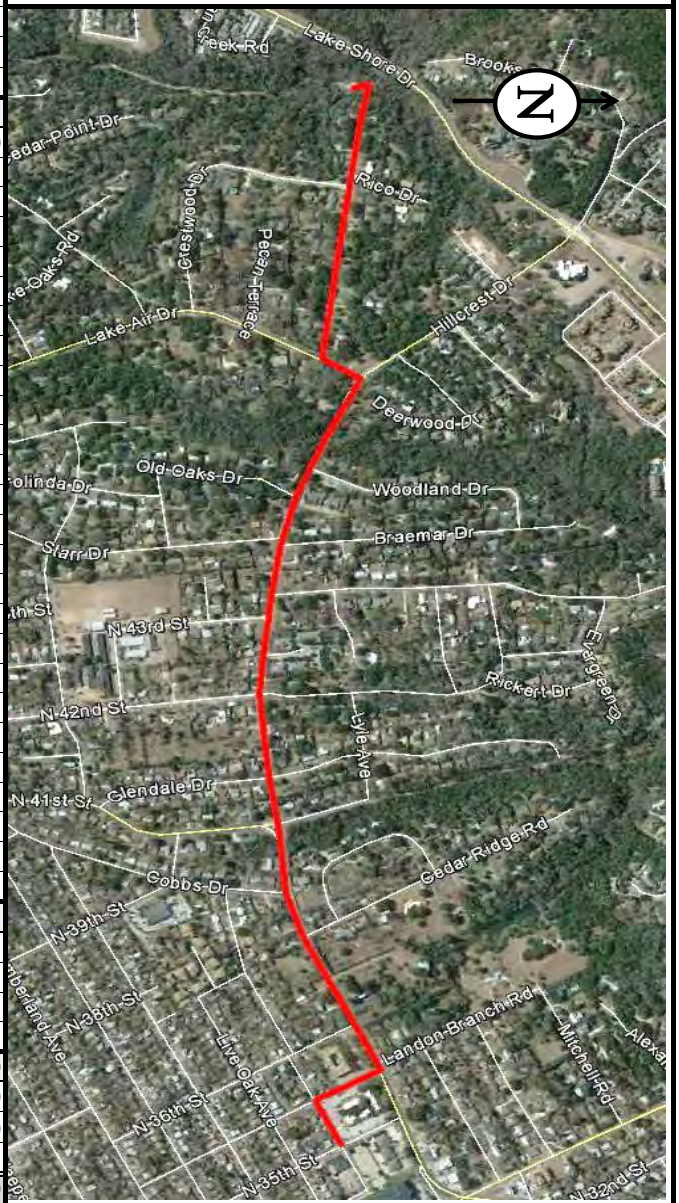
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: ---	☑ Open Cut ☐ Other: _____
Force Main: 12"	☐ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☑ Other Reroute of flows	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$29,000.00	$29,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	1.6	$4,000.00	$6,400.00
Pavement Repair	LF	7645	$45.00	$344,025.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
12" Force Main (All Depths) - Urban	LF	7935	$100.00	$793,500.00
Trenchless				
Construction Subtotal				$1,182,925.00
Engineering (12.5%)				$147,900.00
Construction Contingency (25%)				$295,700.00
Total Estimated Project Cost				$1,626,525.00

Comments

Reroute Wooded Acres LS flow from the Cottonwood Basin to new Brazos Basin Int (Project 4 & 7) through new 12" force main; connect to 24" at intersection of N 35th St and Pine Ave; route generally follows Hillcrest Dr.



Design Timeframe:	2019	Construction Timeframe:	2020-21	By:	JRH	Date:	5/12/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
14	Landon Branch Lift Station Added Pumping Capacity

Total Project Length (FT)	Location (Nearest Street Intersection)
N\A	Begin Project: 2729 Glendale Drive (Exisitng Landon Branch Lift Station) End Project:

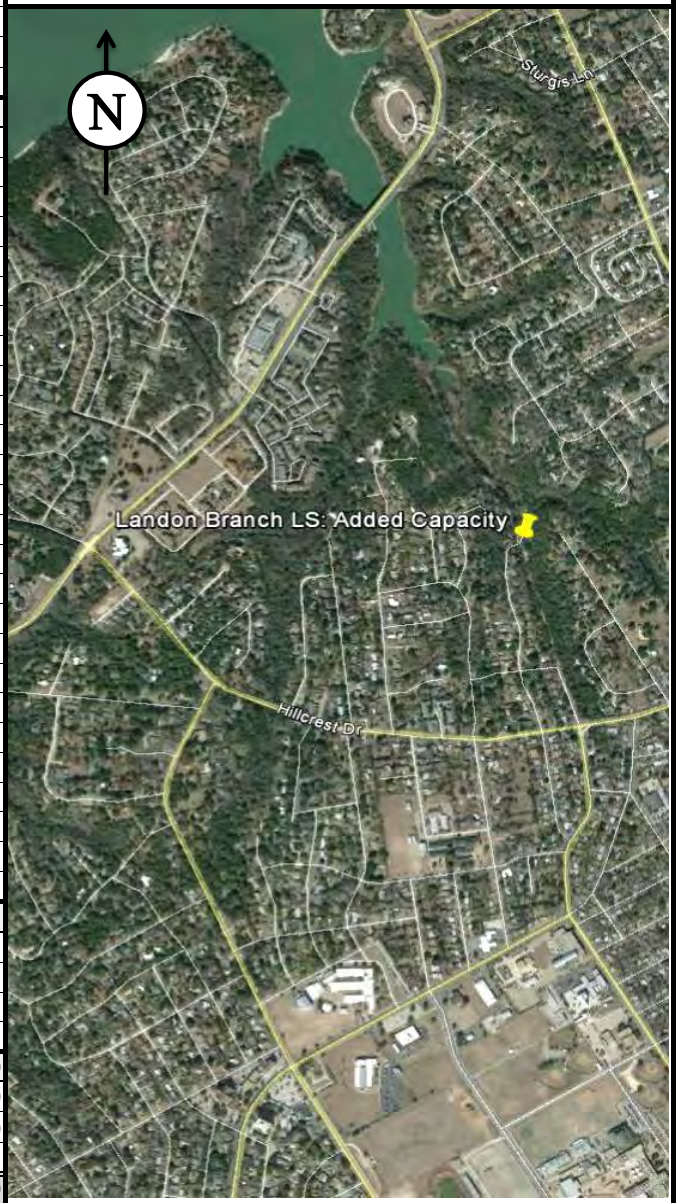
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: N/A Force Main: N/A	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☐ Existing R.O.W	ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$84,000.00	$84,000.00
New Lift Station (3.0 MGD)	LS	1	$1,050,000.00	$1,050,000.00
Open Trench				
Trenchless				
Construction Subtotal				$1,134,000.00
Engineering (12.5%)				$141,800.00
Construction Contingency (25%)				$283,500.00
Total Estimated Project Cost				$1,559,300.00

Comments

Replace Landon Branch Lift Station with a new, 3 MGD lift station due to age and deterioration; also will allow the reroute of flows from Village Green, Park Lake, Chimney Hill, and Greenleaf Lift Stations to Landon Branch and new Brazos Basin Interceptor.



Design Timeframe:	2019	Construction Timeframe:	2020-21	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
15	TSTC Lift Station Added Capacity and Force Main Improvements

Total Project Length (FT)	Location (Nearest Street Intersection)	
10,745	Begin Project:	8400 E Hwy 84 (Existing TSTC Lift Station)
	End Project:	South of Williams Dr and Katy Ln

CITY OF WACO

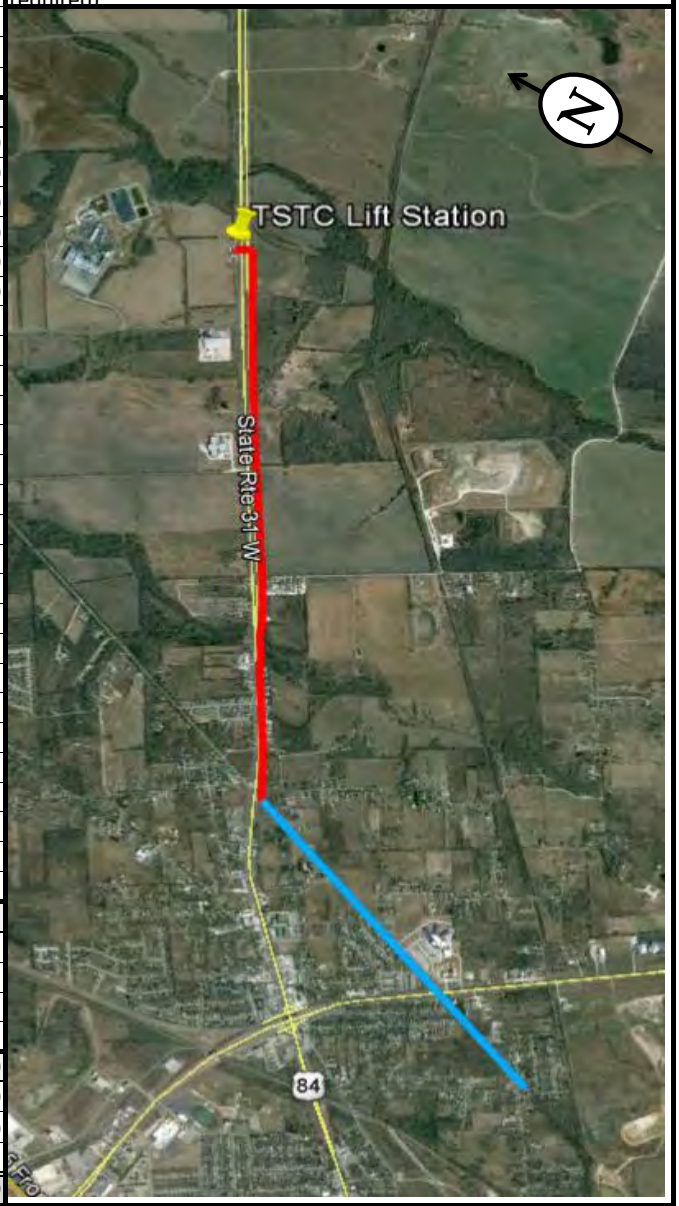
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: ---	☑ Open Cut ☐ Other: _____
Force Main: 16"	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$348,000.00	$348,000.00
Pavement Repair	LF	595	$45.00	$26,775.00
Lift Station Added Capacity (Expan. 0.5 MGD)	LS	1	$350,000.00	$350,000.00
Open Trench				
16" Force Main (All Depths) - Urban	LF	10745	$140.00	$1,504,300.00
24" Boring and Casing	LF	500	$425.00	$212,500.00
24" Gravity (All Depths) - Urban	LF	7110	$245.00	$1,741,950.00
36" Boring and Casing	LF	470	$660.00	$310,200.00
6' Diameter Concrete Manhole	EA	15	$10,500.00	$157,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	180	$275.00	$49,500.00
Trenchless				
Construction Subtotal				$4,700,725.00
Engineering (12.5%)				$587,600.00
Construction Contingency (25%)				$1,175,200.00
Total Estimated Project Cost				$6,463,525.00

Comments

Increase capacity at the existing TSTC LS; replace existing 16" force main with new 16" force main beginning at existing TSTC LS to intersection of Hwy 84/Bellmead Dr and Williams Dr; begin 24" gravity and tie into proposed WMARSS Bell/LL/TSTC Int (Project 8); all flow currently goes through 8" force main (no Temporary By-Pass required)



Design Timeframe:	2020	Construction Timeframe:	2021-22	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
16	Lindsey Hollow Lift Station Abandonment and Gravity Extension

Total Project Length (FT)	Location (Nearest Street Intersection)	
3,840	Begin Project:	2508 Lindsey Hollow Rd (Existing Linsey Hollow Lift Station)
	End Project:	30" Gravity on South Side of Cameron Park Drive

CITY OF WACO

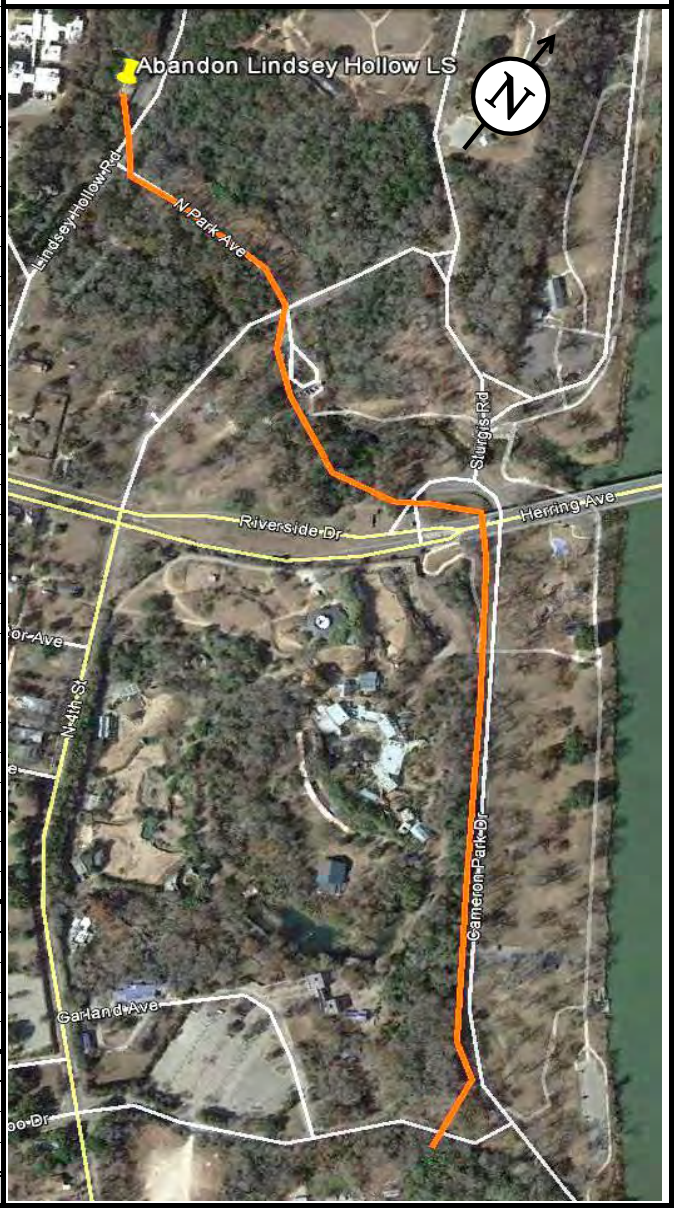
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 30"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☐ Asset Renewal	☐ Existing Easement	ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☐ Existing R.O.W	ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$150,000.00	$150,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	5	$4,000.00	$20,000.00
Pavement Repair	LF	2680	$45.00	$120,600.00
Landscape/Fence Repair	LS	1	$8,000.00	$8,000.00
Lift Station Demolition	LS	1	$20,000.00	$20,000.00
Open Trench				
30" Gravity (Or Trenchless Construction) - Urban	LF	3840	$350.00	$1,344,000.00
48" Boring and Casing	LF	150	$825.00	$123,750.00
6' Diameter Concrete Manhole	EA	18	$10,500.00	$189,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	180	$275.00	$49,500.00
Trenchless				
Construction Subtotal				$2,024,850.00
Engineering (12.5%)				$253,100.00
Construction Contingency (25%)				$506,200.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)				$33,600.00
Total Estimated Project Cost				$2,817,750.00

Comments

Abandon existing Lindsey Hollow Lift Station; begin 30" gravity at existing lift station and tie in to existing 30" gravity on the south side of Cameron Park Drive between Cameron Park Zoo Dr and N 4th St (end of Project 11)



Design Timeframe:	2020	Construction Timeframe:	2021	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
17	Barron's Branch Added Capacity Wastewater Line

Total Project Length (FT)	Location (Nearest Street Intersection)	
8,535	Begin Project:	N University Parks Drive and Jefferson Avenue
	End Project:	N 16th Street and Cumberland Avenue

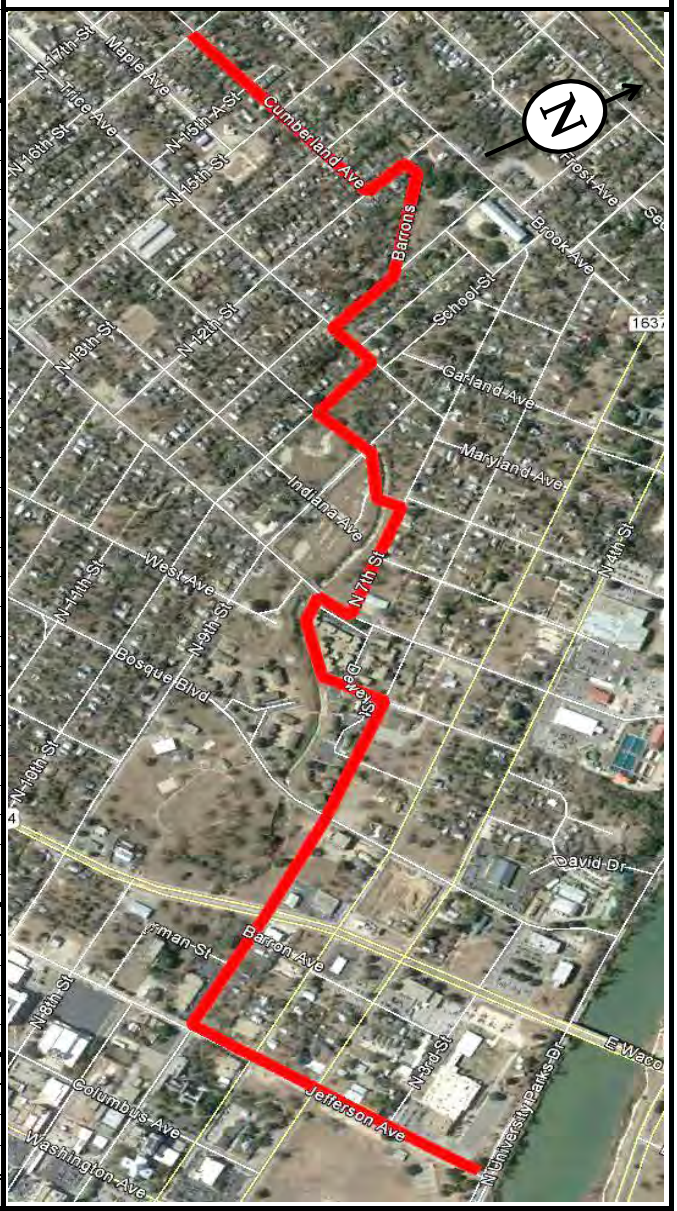
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 18"-24"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	Varies ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$230,000.00	$230,000.00
Sanitary Sewer Service	EA	40	$1,250.00	$50,000.00
Pavement Repair	LF	5510	$45.00	$247,950.00
Temporary Pump-Around By-Pass Pumping	LS	1	$80,000.00	$80,000.00
Landscape/Fence Repair	LS	1	$10,000.00	$10,000.00
Open Trench				
18" Gravity (All Depths) - Urban	LF	3735	$165.00	$616,275.00
21" Gravity (All Depths) - Urban	LF	3670	$190.00	$697,300.00
30" Boring and Casing	LF	240	$525.00	$126,000.00
24" Gravity (All Depths) - Urban	LF	1130	$245.00	$276,850.00
36" Boring and Casing	LF	270	$660.00	$178,200.00
6' Diameter Concrete Manhole	EA	45	$10,500.00	$472,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	450	$275.00	$123,750.00
Trenchless				
Construction Subtotal				$3,108,825.00
Engineering (12.5%)				$388,600.00
Construction Contingecy (25%)				$777,200.00
Easement Acquisition (25' Width x 360' Length x $0.35 per square foot)				$3,200.00
Total Estimated Project Cost				$4,277,825.00

Comments

Begin 24" gravity at the intersection of N 3rd St and Jefferson Ave to N 6th St and Jefferson Ave; begin 21" to N 7th St and Colcord Ave; begin 18" to N 12th St between Brook Ave and Cumberland Ave; begin 12" and end at N 16th St and Cumberland Ave



Design Timeframe:	2021	Construction Timeframe:	2022	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
19	Cottonwood Basin Added Capacity Wastewater Line

CITY OF WACO

Total Project Length (FT)	Location (Nearest Street Intersection)	
11,920	Begin Project:	North of Approximately 4586 Hiland Drive
	End Project:	Waco Creek crossing near Sanger Ave and Westview Dr

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 15"-30"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	Varies ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$405,000.00	$405,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	40.3	$4,000.00	$161,200.00
Sanitary Sewer Service	EA	40	$1,250.00	$50,000.00
Pavement Repair	LF	5080	$45.00	$228,600.00
Temporary Pump-Around By-Pass Pumping	LS	1	$120,000.00	$120,000.00
Landscape/Fence Repair	LS	1	$15,000.00	$15,000.00
Open Trench				
15" Gravity (All Depths) - Urban	LF	3715	$140.00	$520,100.00
24" Boring and Casing	LF	470	$425.00	$199,750.00
4' Diameter Concrete Manhole	EA	15	$7,500.00	$112,500.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	150	$200.00	$30,000.00
18" Gravity (All Depths) - Urban	LF	320	$165.00	$52,800.00
30" Boring and Casing	LF	400	$525.00	$210,000.00
24" Gravity (All Depths) - Urban	LF	3610	$245.00	$884,450.00
36" Boring and Casing	LF	250	$660.00	$165,000.00
30" Gravity (All Depths) - Urban	LF	4765	$350.00	$1,667,750.00
48" Boring and Casing	LF	830	$825.00	$684,750.00
6' Diameter Concrete Manhole	EA	35	$10,500.00	$367,500.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	400	$275.00	$110,000.00
Trenchless				

Comments

Begin 30" at Hiland Dr Reroute flow split on north side of creek north of Hiland Dr and end at 10" tie-in west of Gold's Gym; begin 24" and end on the east side of creek just south of Valley Mills Dr; begin 18" and end at the intersection of Valley Mills Dr and Greer St; begin 15" and end on southwest corner of Bosque Blvd and Wooded Acres Dr

Construction Subtotal	$5,984,400.00
Engineering (12.5%)	$748,100.00
Construction Contingency (25%)	$1,496,100.00
Easement Acquisition (25' Width x Length x $0.35 per square foot)	$43,800.00
Total Estimated Project Cost	$8,272,400.00

Design Timeframe:	2021	**Construction Timeframe:**	2022-23	**By:** JRH	**Date:** 5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
21	McLennan County Jail Abandonment and Gravity Extension

Total Project Length (FT)	Location (Nearest Street Intersection)	
3,735	Begin Project:	2001 Old Marlin Hwy / S Hwy 6
	End Project:	Existing McLennan County Jail Lift Station

CITY OF WACO

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 15"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	30 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☐ Existing R.O.W	ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$64,000.00	$64,000.00
Sanitary Sewer Service	EA	5	$1,250.00	$6,250.00
Pavement Repair	LF	910	$45.00	$40,950.00
Temporary Pump-Around By-Pass Pumping	LS	1	$90,000.00	$90,000.00
Lift Station Demolition	LS	1	$10,000.00	$10,000.00
Open Trench				
15" Gravity (All Depths) - Urban	LF	3735	$140.00	$522,900.00
24" Boring and Casing	LF	80	$425.00	$34,000.00
4' Diameter Concrete Manhole	EA	8	$7,500.00	$60,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	VF	160	$200.00	$32,000.00
Trenchless				
Construction Subtotal				$860,100.00
Engineering (12.5%)				$107,500.00
Construction Contingecy (25%)				$215,000.00
Easement Acquisition (25' Width x 500 Length x $0.35 per square foot)				$4,400.00
Total Estimated Project Cost				$1,187,000.00

Comments

Abandon existing McLennan County Jail LS; extend 15" gravity from existing lift station to new LaSalle Lift Station site (1-10 Year CIP Project #1/WMARSS Project #1)

Design Timeframe:	2022	Construction Timeframe:	2023	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
22	Lake Shore Lift Station and Force Main Replacement

Total Project Length (FT)	Location (Nearest Street Intersection)	
3,760	Begin Project:	2801 Lake Shore Dr (Existing Lake Shore Lift Station)
	End Project:	La Porte Dr and Huntington Dr

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: ---	☑ Open Cut ☐ Other: _____
Force Main: 10"	☐ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☑ Asset Renewal	☑ Existing Easement	Varies ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$95,000.00	$95,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	16	$4,000.00	$64,000.00
Pavement Repair	LF	1265	$45.00	$56,925.00
Temporary Pump-Around By-Pass Pumping	LS	1	$60,000.00	$60,000.00
New Lift Station (1.25 MGD)	LS	1	$640,000.00	$640,000.00
Lift Station Demolition	LS	1	$10,000.00	$10,000.00
Open Trench				
10" Force Main (All Depths) - Rural	LF	2500	$95.00	$237,500.00
10" Force Main (All Depths) - Urban	LF	1260	$95.00	$119,700.00
Trenchless				
Construction Subtotal				$1,283,125.00
Engineering (12.5%)				$160,400.00
Construction Contingency (25%)				$320,800.00
Total Estimated Project Cost				$1,764,325.00

Comments

Replace Lake Shore Lift Station and force main in order to accommodate for future flows and rehabilitate existing structures and components.

Design Timeframe:	2022	Construction Timeframe:	2023	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
24	Gravity Line Upstream of Church Road Lift Station

Total Project Length (FT)	Location (Nearest Street Intersection)	
12,900	Begin Project:	669 Church Rd (Existing Church Road Lift Station)
	End Project:	Extension of Woodhaven Trail to the Southeast

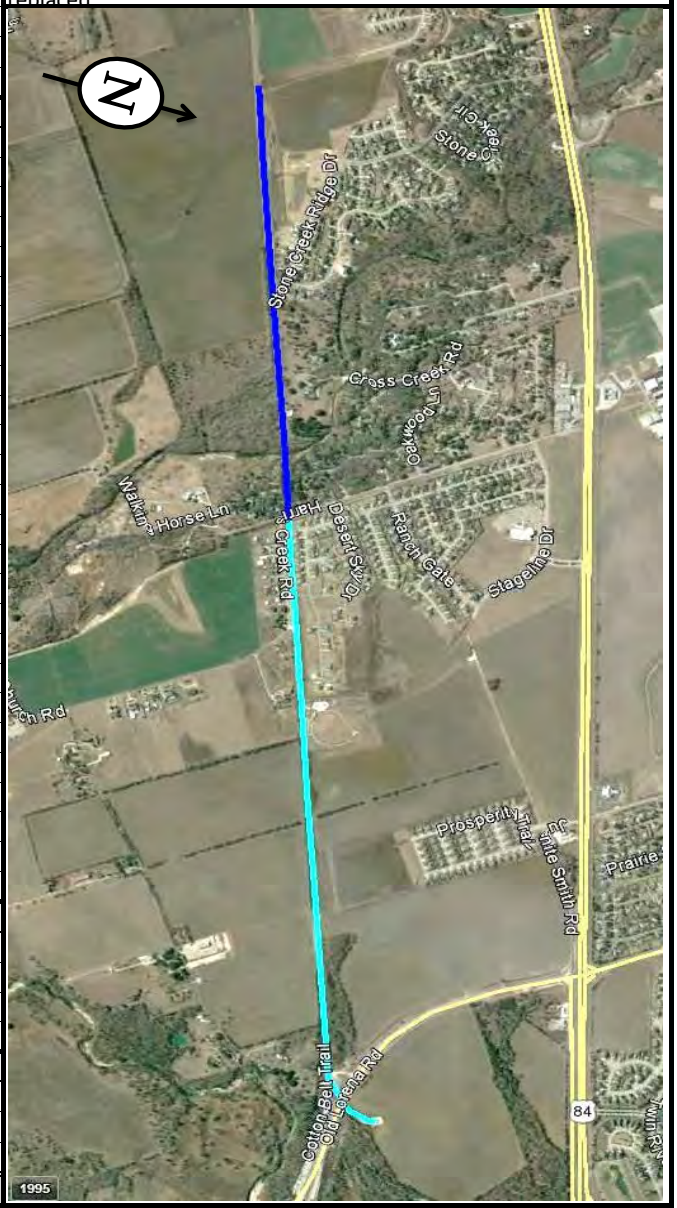
Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 18"-30"	☑ Open Cut ☐ Other: _____
Force Main: ---	☑ Trenchless

Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	20 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☐ Existing R.O.W	ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$304,000.00	$304,000.00
Pavement Repair	LF	4150	$45.00	$186,750.00
Temporary Pump-Around By-Pass Pumping	LS	1	$80,000.00	$80,000.00
Landscape/Fence Repair	LS	1	$2,000.00	$2,000.00
Open Trench				
18" Gravity (All Depths) - Rural	LF	2470	$150.00	$370,500.00
21" Gravity (All Depths) - Rural	LF	1505	$175.00	$263,375.00
24" Gravity (All Depths) - Rural	LF	1315	$195.00	$256,425.00
36" Boring and Casing	LF	340	$660.00	$224,400.00
30" Gravity (All Depths) - Rural	LF	7610	$280.00	$2,130,800.00
48" Boring and Casing	LF	300	$825.00	$247,500.00
6' Diameter Concrete Manhole	EA	30	$10,500.00	$315,000.00
Extra Depth for 6' Diameter Manhole Over 5' Deep	VF	360	$275.00	$99,000.00
Trenchless				
Construction Subtotal				$4,479,750.00
Engineering (12.5%)				$560,000.00
Construction Contingecy (25%)				$1,119,900.00
Total Estimated Project Cost				$6,159,650.00

Comments

Begin 30" at existing Church Rd LS to Harris Creek Rd and Walking Horse Ln; begin 24" to southwest of Cross Creek Rd; begin 21" to 8" tie-in south of Stone Creek Ridge Dr; begin 18" and end at the 8" tie-in for Trails of Oak Ridge (18" tie-in point to Waco system for Smith Rd extension project); assumed entire concrete trail needs to be replaced



Design Timeframe:	2023	Construction Timeframe:	2024	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
25	Village Green and Park Lake Lift Stations Flow Reroute

Total Project Length (FT)	Location (Nearest Street Intersection)	
4,285	Begin Project:	4700 Village Oak (Existing Village Green Lift Station)
	End Project:	Lake Shore Drive and Greenleaf Drive

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: 15"	☑ Open Cut ☐ Other: _____
Force Main: 8", 12"	☑ Trenchless

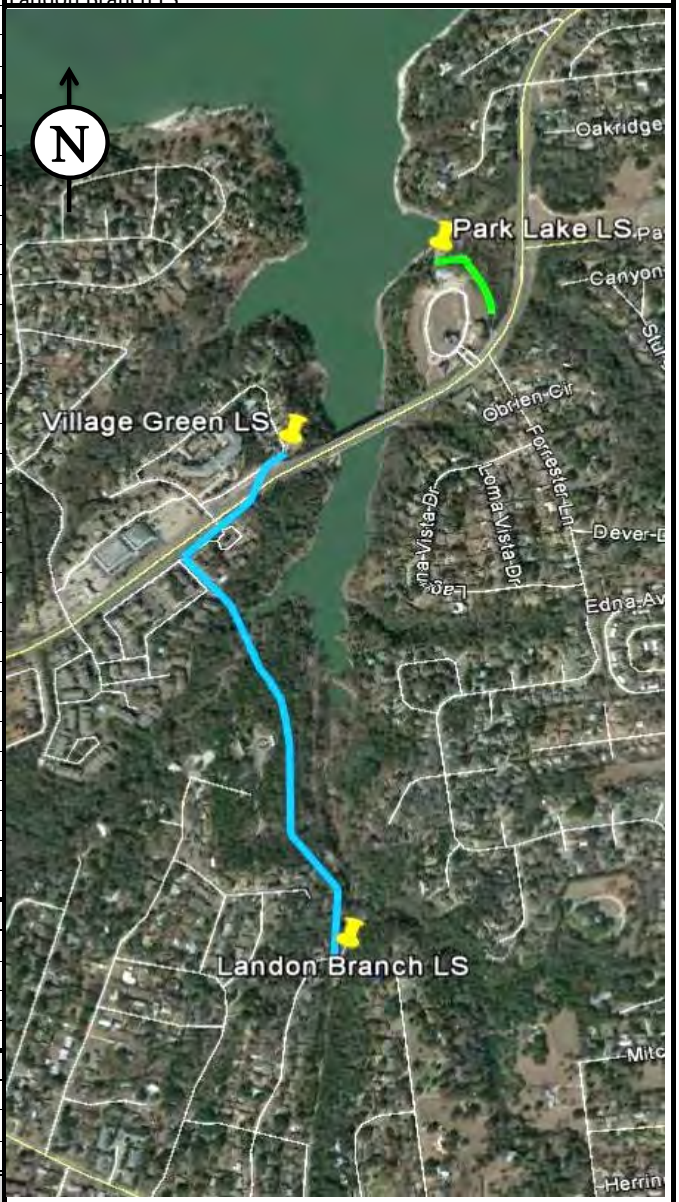
Project Type		R.O.W. / Easements (Width)	
☑ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	20 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	80 ft.
☐ Lift Station Upgrades/Removal	☐ Other _____	☑ Requires Easement	25 ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$62,000.00	$62,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	24.6	$4,000.00	$98,400.00
Pavement Repair	LF	350	$45.00	$15,750.00
Temporary Pump-Around By-Pass Pumping	LS	1	$40,000.00	$40,000.00
Landscape/Fence Repair	LS	1	$5,000.00	$5,000.00
Open Trench				
8" Force Main (or Trenchless Construction) - Urban	LF	585	$85.00	$49,725.00
12" Force Main (All Depths) - Urban	LF	1800	$100.00	$180,000.00
18" Boring and Casing	LF	190	$325.00	$61,750.00
15" Gravity (All Depths) - Urban	LF	1900	$140.00	$266,000.00
4' Diameter Concrete Manhole	LF	6	$7,500.00	$45,000.00
Extra Depth for 4' Diameter Manhole Over 5' Deep	LF	70	$200.00	$14,000.00
Trenchless				

Construction Subtotal	$837,625.00
Engineering (12.5%)	$104,700.00
Construction Contingency (25%)	$209,400.00
Easement Acquisition (25' Width x 840' Length x $0.35 per square foot)	$7,400.00
Total Estimated Project Cost	$1,159,125.00

Comments

Reroute Park Lake LS flows to Village Green LS; begin new 8" force main at existing Park Lake LS and tie into existing 8" force main; Reroute Village Green LS to flow to upgraded Landon Branch LS; begin new 12" force main at existing LS to beginning of 15" gravity on south side of branch into Lake Waco; end gravity at upgraded Landon Branch LS



Design Timeframe:	2023	Construction Timeframe:	2024	By:	JRH	Date:	5/8/15

1-10 Year Capital Improvement Plan Project Form

Project Number:	Project Name
26	Syrian Club Lift Station and Force Main Replacement

Total Project Length (FT)	Location (Nearest Street Intersection)
N\A	Begin Project: 8500 Old McGregor Rd (Existing Syrian Club Lift Station) End Project:

CITY OF WACO

Prop. Pipe Diameter (IN)	Recommended Replacement Type
Gravity: N/A Force Main: N/A	☐ Open Cut ☐ Other: _____ ☐ Trenchless

Project Type		R.O.W. / Easements (Width)	
☐ Address Ex. Insufficient Capacity	☐ Asset Renewal	☑ Existing Easement	15 ft.
☐ Provide Future Hydraulic Capacity	☐ WMARSS	☑ Existing R.O.W	Varies ft.
☑ Lift Station Upgrades/Removal	☐ Other _____	☐ Requires Easement	ft.

Description	Unit	Est. Qty.	Unit Price	Total
General				
Mobilization / Project Incidentals (8%)	LS	1	$57,000.00	$57,000.00
Prepare Right-of-Way (Highly Wooded Areas)	STA	3	$4,000.00	$12,000.00
Pavement Repair	LF	270	$45.00	$12,150.00
Temporary Pump-Around By-Pass Pumping	LS	1	$25,000.00	$25,000.00
Landscape/Fence Repair	LS	1	$15,000.00	$15,000.00
New Lift Station (0.5 MGD)	LS	1	$500,000.00	$500,000.00
Lift Station Demolition	LS	1	$10,000.00	$10,000.00
Open Trench				
6" Force Main (All Depths) - Rural	LF	530	$60.00	$31,800.00
6" Force Main (All Depths) - Urban	LF	890	$70.00	$62,300.00
12" Boring and Casing	LF	250	$185.00	$46,250.00
Trenchless				
Construction Subtotal				$771,500.00
Engineering (12.5%)				$96,400.00
Construction Contingency (25%)				$192,900.00
Total Estimated Project Cost				$1,060,800.00

Comments

Replace Syrian Club Lift Station and force main in order to accommodate future flows and rehabilitate existing structures and components.

Design Timeframe:	2023	Construction Timeframe:	2024	By:	JRH	Date:	5/8/15